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Agricultural Journal.

Issued by Authority of
the Minister of Agriculture and Lands

Vol. XXXVII., No. 1.] JANUARY, 1940. 15s. per annum

LEADING FEATURES.

TREES AND WILD FLOWERS ON THE RHODESIAN FARM
PART XI

FARMING CALENDAR JANUARY

COMPOST NOTES.

WHEAT VARIETIES TESTED AT SALISBURY

THE SUMMER FATTENING OF BULLOCKS

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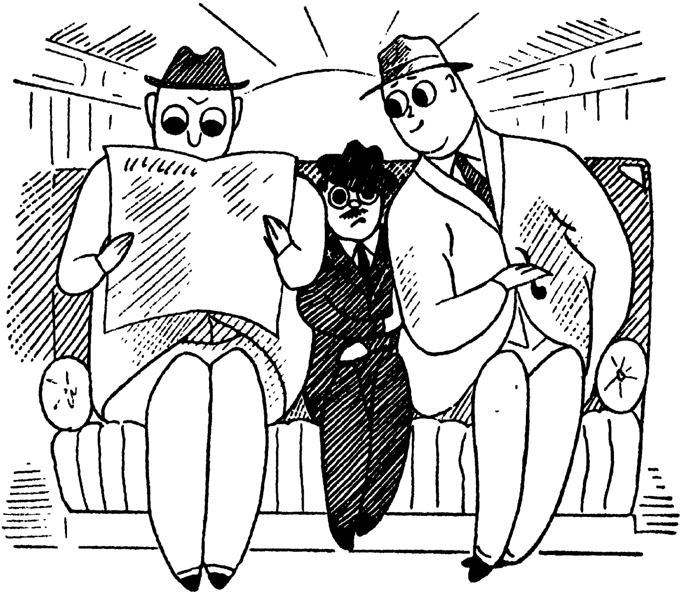

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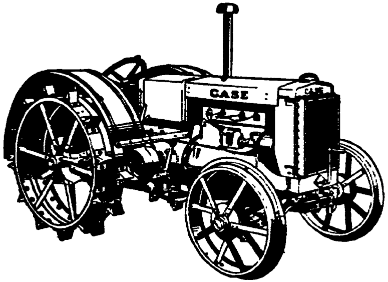

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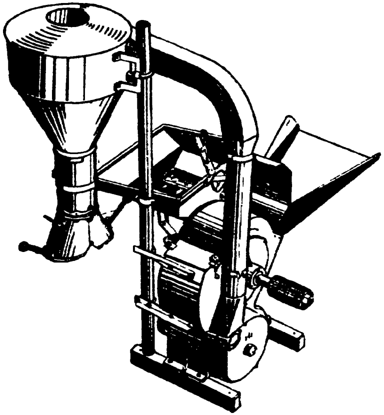

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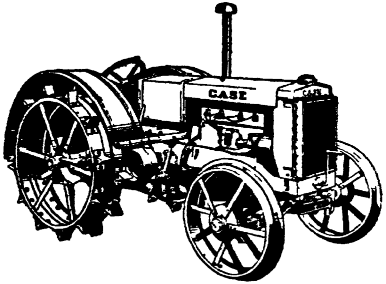

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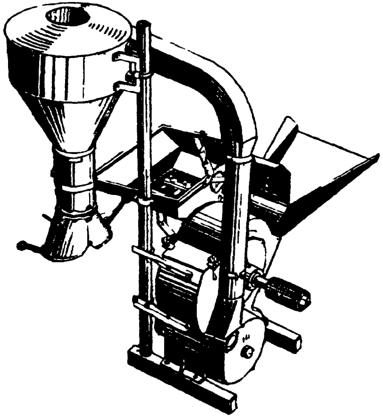

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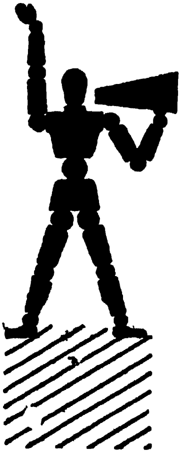

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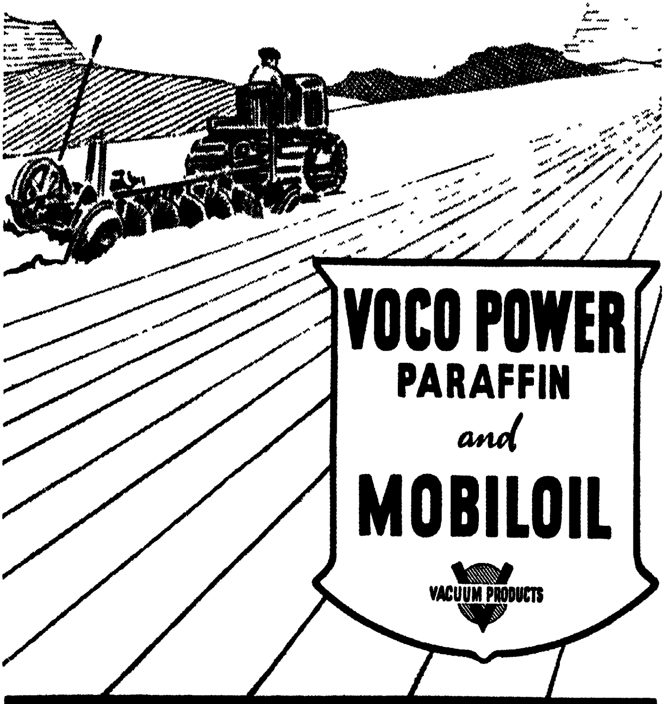

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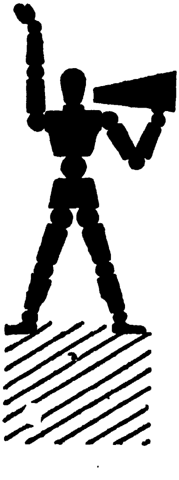

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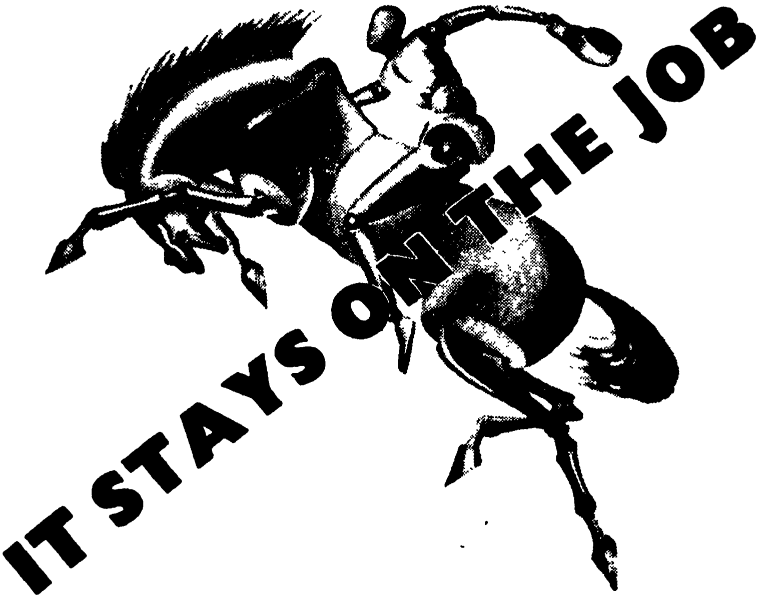
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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

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Compost for Tobacco.—Capt. J. M. Moubray, of Chipoli, Shamva, supplies the following interesting information in a letter written to the Editor on December 5th:—

"Mr. Rawson, of Darwendale, writes that compost on his tobacco seed-beds is proving a great success. Plants on composted ground are making, up to the present, exactly twice the growth of ordinary fertiliser seedlings.

"It is most important to emphasise that only ripe compost should be used. The use of half made compost is worse than no compost at all.

"Another point that has now been proved is that compost grown seedlings are able to take the sun at a much earlier stage than those grown with fertiliser alone. The result is a strong stocky plant with a well developed root system. In a bad planting season this is a very important point, as the number of failures is very much lessened.

"It is now known that the tobacco plant is a mycorrhiza former. This has an important bearing on methods concerned with its culture."

Preserving Eggs.—It is surprising that more use is not made of the simple methods of preserving eggs. If put in preservative when quite fresh and stored in a cool place, a cellar or cool chamber for preference, they will keep in perfectly good condition for a year or eighteen months. In this way the housewife in town could take advantage of our short seasons of plenty and avoid buying in the scarce season.

Lime Water.—An egg pickle composed of lime, salt, cream of tartar and water, was patented upwards of a hundred years ago, and a modification of this preparation is still used extensively. The pickle as now generally employed is made by mixing four parts by measure of finely slaked lime with 20 parts of cold water, and afterwards adding one part of salt. This solution should be prepared by mixing the lime and the water a week before it is to be used, and stirring well together daily, adding the salt on the fourth or fifth day. The eggs should be placed in vats, barrels or crocks, and the cleared solution poured over them, care being taken to avoid adding any of the lime sediment, otherwise there is a danger of the solution becoming a solid mass. The vessel should not be filled with eggs, but two or three inches of the solution should rest above the top layer. A little fresh solution should be added occasionally, in order to provide for evaporation. An egg preserved by this method can easily be recognised by the roughness of the shell. When the egg is boiled the shell will crack, a result due to the effect of the lime upon the outer covering, causing it to be hard and brittle. Preserved eggs are not recommended for boiling but, if it is desired to use them in this way, the cracking may generally be prevented by pricking the broad end with a needle immediately before the egg is boiled.

Waterglass.—Waterglass is a strong solution of silicate of soda in water varying in specific gravity, according to the amount of silicate dissolved. The strongest solution usually found in commerce has a specific gravity of 1.7 and contains approximately equal parts by weight of sodium silicate and water. A ready means of ascertaining whether the waterglass is uniform in different supplies would be to weigh a measured ounce of the waterglass. One ounce by measure of the concentrated solution of specific gravity 1.7 should weigh 1.7 ozs., or nearly $1\frac{3}{4}$ ozs.; if it weighs less than this it contains less silicate, and more of the waterglass should, therefore, be used in making the dilute solution.

In preparing the waterglass for use, five or ten times its bulk of clean boiling water should be added to the concentrated solution, according to its strength. The preparation should be quite cold before it is used. A 5 per cent. solution may be used with safety, and with this strength there is less danger of giving the eggs an objectionable flavour than with the stronger solution. When the waterglass is added to the water the two must be very carefully and thoroughly mixed. The eggs may be dipped in the waterglass and dried off, leaving a film on the shell, and then stored upon shelves, or they may be kept in the liquid until sold or used. The latter method is to be preferred. When they are taken out of the solution they are sticky, and before packing should be washed and dried.

It has been shown that the changes in eggs preserved in waterglass take place very gradually; at one year old they are hardly noticeable, at two years they are distinct, but not so distinct as at three or four years old.

General Suggestions.—1. Eggs for preservation should be treated as soon as possible after they have been laid, but not until they have been cooled. If the egg is not absolutely fresh when placed in the preserving medium the final result cannot be entirely satisfactory. An egg twenty-four hours old is superior to one a week old.

2. Eggs must not be stored in a warm place before preservation, and where lime water or water glass is used the preparation should be quite cold before the eggs are placed in the solution.

3. Eggs from hens fed chiefly upon grain, and with full liberty, are likely to keep better than those laid by fowls in confined runs.

4. The general experience has been that infertile eggs keep in good condition longer than those which contain a living germ. Probably this is less apparent when eggs are preserved at a low temperature.

5. Eggs may be stored in large or small quantities, and may be allowed to remain in pickle for six months. Wooden, cement or galvanised iron vessels should be employed.

6. Eggs should be carefully tested before they are preserved, and again prior to sale. For this purpose a well constructed candling lamp is to be preferred; but a piece of black cardboard 8 inches square, with an oval hole in the centre rather smaller than an ordinary egg, can be used. Each egg should be placed against the hole, and held between a strong light and the eye, so that the condition of the contents can be observed. In the final test all eggs of which the contents are opaque or which show spots or black shadows should be rejected.

The Production of Chamomile Flowers.—The following notes taken from a recent number of the *Bulletin of the Imperial Institute* will be of interest to those farmers who are interested in testing new crops under our conditions:—

"There are two cultivated forms of chamomile which enter into commerce, the material derived from the so-called English or Roman chamomile (*Anthemis nobilis*), which is a perennial plant, and that from the German chamomile (*Matricaria chamomilla*), which is an annual plant. The former, which is cultivated in this country and various continental countries, is the source of the product commonly marketed in the United Kingdom. It is used for toilet and medicinal preparations and was formerly official in the British Pharmacopoeia.

"Chomomile does not appear to be an exacting crop so far as soil conditions are concerned, as it will grow on both clayey and sandy soils, but the best results are stated to be obtained from deep, light, rich and fresh soils.

"The land must be thoroughly clean, requires deep cultivation, and farmyard or artificial manures must be applied as required.

"In Europe the crop is planted from December to March or even late April, but the earlier planted areas are said to give the best yields. The plants are generally propagated by means of one-year-old slips, which are obtained from selected plants. Propagation from seed is generally unsatisfactory, as a proportion of the plants is liable to produce single flowers, which are not required by the market. The slips are planted, in clumps of three or four, in rows 1½ ft. to 2½ ft. apart, separated by 15 in. in the row. Regular weedings are called for during the growing period.

"The crop may remain on the same land for several years, in which case the plants require thinning to remove excess or irregular growth. More satisfactory results, however, are obtained, and yields are better maintained, when the crop is ploughed in and the land replanted with slips every two or three years.

"Flowering usually begins in June when the plantations were laid down in March, and the flowers improve as the season advances. The collection of the flowerheads is a continuous process which takes place just as the flowers open and become fully developed; gathering should not take place when the flowers are wet with dew or rain, as this tends to turn them black. Picking, when done by hand, is mostly carried out by women and children, who harvest from 12 or 13 lb. to 16 or 17 lb. a day. Yields ranging from 400 to

1,000 lb. of dry flowers are stated to be obtained from one acre, depending on the season.

"Drying should be effected as rapidly as possible under conditions which enable the flowers to retain their white colour. The exact method to be followed will, naturally, vary according to local conditions. The drying may be carried out in the sun on racks or trays or in heated drying sheds or lofts. The flowerheads are spread out in thin layers and turned at intervals in order to prevent overheating and consequent deterioration. When the drying process has been completed the flowerheads are graded and packed in paper-lined plywood boxes."

Agricultural Cleanliness Hints for January.—The indications that the present season is to be one of subnormal rainfall and the fact that much rain has already fallen suggest the possible occurrence of either long or numerous periods of dry weather. Because of the greater accessibility to lands and the increased susceptibility of weeds to operations directed against them under these conditions, weed control should be a more simple task than usual. *Advantage* should be taken of the opportunity should it occur.

Tobacco primings, diseased plants, and unthrifty plants that are not likely to produce leaf worth curing should be destroyed forthwith and not merely be left on the edge of the land where aphis, whitefly, leaf miner, and other pests, including diseases, can complete their development and so add to the numbers of those that may already be on the crop. Seed-beds no longer required should be dug over. A final thorough cleaning of tobacco sheds can be made when rain interferes with out-door work.

Beans and cowpeas infested with stem weevil grubs should be destroyed to prevent further infestation.

The further breeding of melon fly, fruit fly, false codling moth, etc., can be largely prevented by regularly collecting and destroying all stung fruit and windfalls. If these cannot be consumed immediately by stock, they should be burned, boiled, buried in a hot compost heap, or buried with two feet of soil well packed on top of them.

A Useful Farm Wagon.

An admirable wagon for carting compost to the fields. Built on a 3½ ton lorry chassis at a total cost of only £25 by Mr. Nicolle, of Barkly Estate. It has a very light draught. The body is 21 feet long and has side-delivery, which allows large loads to be carried and spread with ease.

SALES,
Agricultural Experiment Station,
Salisbury.

Kudzu Vine Crowns, per 100 Crowns 15/- delivered at Salisbury Experiment Station, or 25 Crowns 7/6; 50 Crowns 15/- and 100 Crowns 22/6, delivered free by rail to any station or siding in Southern Rhodesia. Delivery during January for dry land. Owing to pressure of other operations it is not possible to deliver Kudzu Crown during December.

Swamp Couch Grass, Creeping False Paspalum and Woolly Finger Grass, 7/6 per bag of roots, delivered free by rail to any siding or station in Southern Rhodesia; supplies limited. Available in January and February.

Sweet Potato Cuttings, 6/- per bag, delivered free by rail to any siding or station in Southern Rhodesia. The following varieties will be available in January:—Calabash Leaf, Early Butter, Linslade.

The prices quoted do not include charges for road motor transport. Cheques should be made payable to the Department of Agriculture, *and preliminary enquiries and subsequent orders* should be addressed to the Agriculturist, Department of Agriculture, Salisbury.

Cash must accompany orders.

Trees and Wild Flowers
ON THE RHODESIAN FARM.

By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

PART XI.

The Tree Euphorbias.—The tree Euphorbias form a distinct feature of the landscape in many parts of the country. They are particularly plentiful in broken granite country and often grow in cracks in solid granite outcrops. They have never been properly studied botanically, and it is quite possible that three or four species occur in the Matopos and elsewhere which have never been recorded. All the tree Euphorbias contain quantities of milky juice which was at one time looked upon as a possible source of rubber, but apparently they have no commercial value for this purpose. We have at least five common species, three of which are easily distinguished; the other two not so clearly marked possibly because of hybrids producing intermediate forms.

Euphorbia tirucalli Linn.—This is the shrubby plant often grown as a hedge. The stems are much branched, perfectly smooth and round and generally yellowish green in colour. Growing under natural conditions it often forms a small tree up to 12 or 15 feet high. Narrow leaves up to ½ inch long occur on the very young tips (Fig. 71). This species was apparently first discovered in East Africa and was taken to India by early Portuguese navigators, where it is used as a hedge plant.

Euphorbia ingens E. Mey.—This is one of the commonest tree Euphorbias and is often planted in gardens. Several old trees are to be seen in gardens in Salisbury, and it is common on the granite hills in many parts of the Colony. Its branches are always mealy in appearance with 4 or rarely 5 blunt edges with paired short spines along the margins. Where the spines occur there is a rounded patch of dark coloured tissues which is known as the spine shield. In this species the spine shield

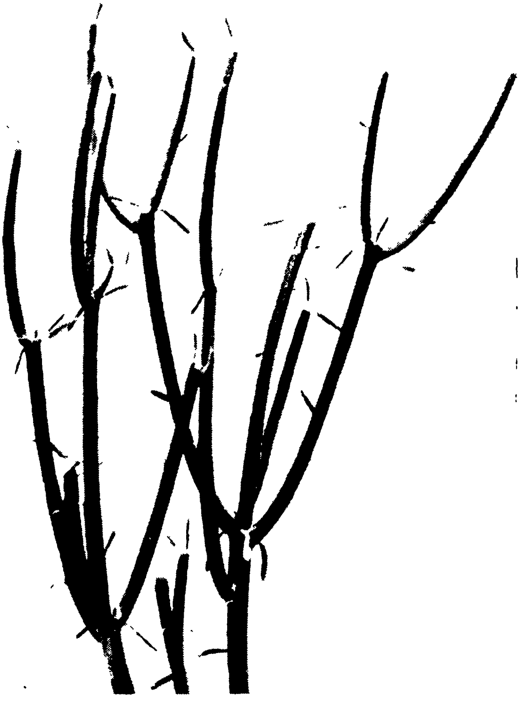


Fig. 71. *Euphorbia tirucalli* Linn. Commonly used as a hedge plant

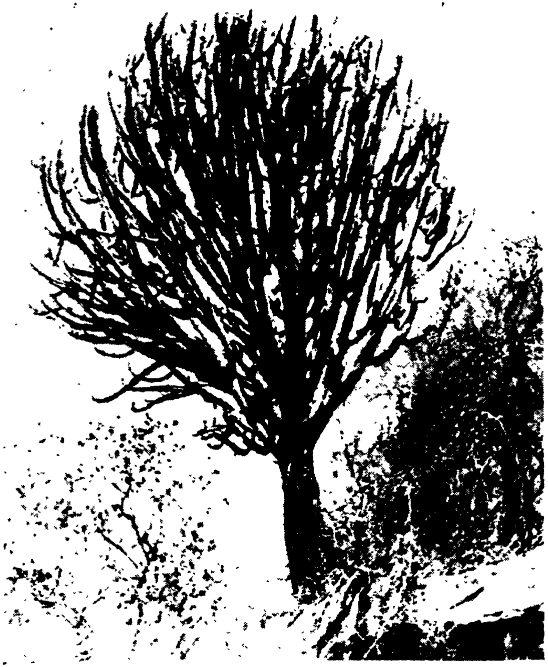


Fig. 72. ***Euphorbia ingens*** **E. Mey.** Common and widespread.

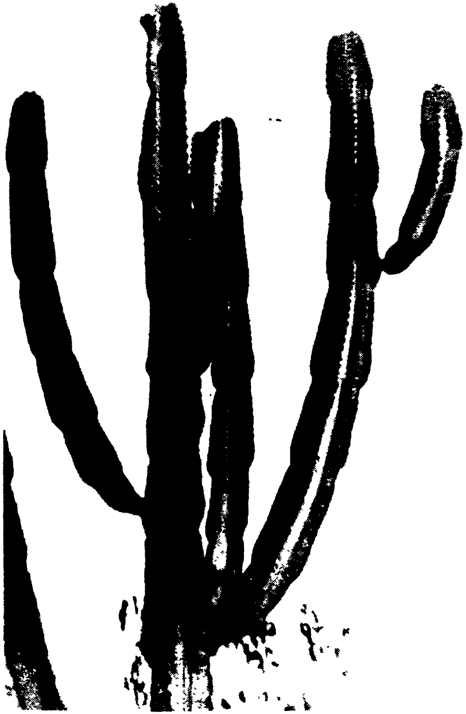


Fig. 72a. Typical branches of a young plant of *E. ingens* E. Mey.

Fig. 73. *Euphorbia similis* Berger End of branch of young tree.

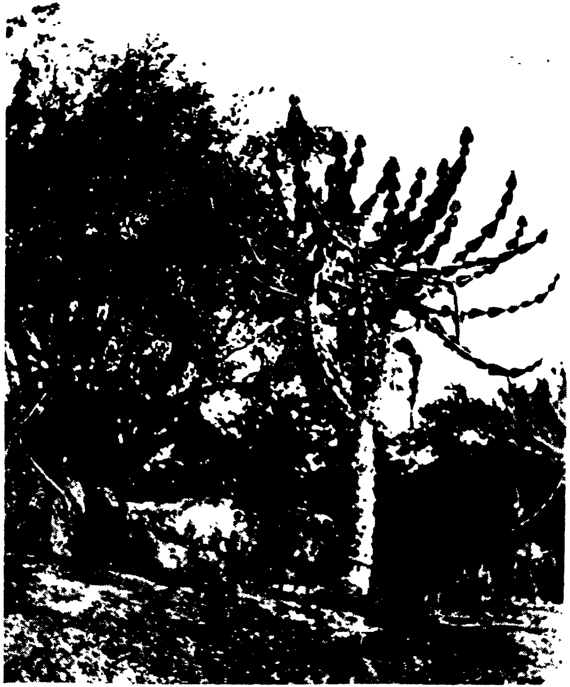


Fig. 74. *Euphorbia strangulata* N.E.Br. Umtali.

is not horny in texture but is powdery and sooty in appearance. The branches are more or less deeply jointed, the end joints being only 2 to 3 inches long. (Fig. 72.)

Euphorbia similis Berger.—This is similar to *ingens* in general appearance and size, often reaching 15 to 20 feet in height. The branches are green, not mealy and white, and are not so conspicuously jointed. The spine-shields are leathery or horny in texture. (Fig. 73.)

Euphorbia angularis Klotzsch.—A succulent spiny bush, when young, or a small tree with a single stem up to about 5 feet high and then a broad, level-topped crown. Branches deeply constricted into joints 3-8 inches long and 2-4½ inches broad. Instead of being 4 or 5-sided the branches in this species are broadly 3-winged, the wings being about 1 to 2 inches broad. The paired spines vary from one-sixth to one-half inch long. This species has been recorded from the Matopos and Gwelo.

Euphorbia strangulata N.E.Br.—A spiny succulent leafless shrub or a small tree, the branches are four-winged and are deeply constricted into segments with the shape of a pyramid, usually 3-4 inches long and about the same width at the top. The margins are thin and the paired spines are short and close together. (Fig. 74.) This has only been recorded from Umtali.

Farming Calendar

FEBRUARY.

FORESTRY.

Tree planting operations should be carried out on dull showery days or late in the afternoon. Take care in setting out the plants, avoid bending the roots, and do not plant deeper than the plants were in the seed beds or trays.

CROPS.

Turn your compost heaps on a wet day. Cultivate, and keep on cultivating as weather permits, to destroy weeds. Continue to look out for stalk borer, and, if infection is discovered, deal with infested plants as advised in January notes. Watch witchweed and continue cultivating and hand-pulling it. Plough under witchweed trap crops within two months from germination. Where practised, maize can be under-planted with sweet potato vines after the last cultivation for the following season's requirements. Potatoes and ground nuts will probably need to be ridged again. Catch crops of quick maturing beans, such as tepary bean, also buckwheat, can still be sown. Keep down all noxious weeds. This work can be undertaken on wet days. Make veld grass hay whenever a few days of fine weather permit. Early mowings provide the best hay. Keep potatoes in a cool shed, well ventilated. Pick over any potatoes in storage and remove bad ones. Continue to make as much farm manure as possible.

STOCK.

Cattle.—The recommendations for January apply equally to this month. Be careful that the condition of the bulls is maintained, especially in the case of well-bred animals. A bull in poor condition cannot be expected to sire a large number of calves. As far as practicable cut veld hay during this month. Usually the optimum relation of yield and composition occurs now. During this month, in addition to maize, some protein concentrate such as peanut cake or cotton-cake will generally be necessary in the dairy cow mixture to keep up a good milk flow. Increase the grain ration to bullocks which are being fattened on grass and add some protein concentrate to their feed to make good the deficiency of this nutrient in the grazing.

Calves may be given a few hours' exercise on bright, sunny days; young stock, however, should not be allowed to run and graze with the herd, and are best kept in a cool, airy pen opening on to a small shady paddock where they can obtain a little exercise.

A good quality of sweet hay and water should always be available for young calves.

Sheep.—Continue as recommended for January. Dose regularly at 21-day intervals for wireworm and bankrot worm with the nicotine and bluestone remedy. Start putting in green food for April and May.

DAIRYING.

This is normally the flush season as far as dairy produce is concerned; dairy cattle are usually in good condition and cows of average capacity should be able to subsist and maintain a full flow of milk on veld grazing alone.

The cheese in the storeroom is apt to develop mould during wet weather. If the cheese is well made and pressed and has a smooth rind, this mould is merely superficial and will not penetrate into the body of the cheese. Rubbing the cheese with a cloth moistened with a weak solution of formalin or permanganate of potash usually checks the development of mould. During these months care must be take not to use over-acid milk for cheese-making, and great care should also be taken of the starter. If this latter shows any signs of gassiness or develops any disagreeable flavour or odour it should be discarded and replaced by a fresh, clean starter. The cheese storeroom must be kept dark and flies excluded.

FLOWER GARDEN.

Sow carnations, phlox, pansy, verbena, gilias, larkspur, dianthus and pentstemon. The flower garden should be now looking at its best, nearly all plants being in bloom. Old and dead flowers should be constantly removed, except when the seed is required. Seeding of the plants shortens their flowering period. All runners and climbers should have constant attention, and be tied up and trained, otherwise they will be damaged by the wind. Dahlias, chrysanthemums and carnations will require staking, as they become top heavy when in flower. Make the first sowing of winter-flowering sweet peas.

VEGETABLE GARDEN.

Sow now—Beans, beet, cabbage, cauliflower, lettuce, peas, onions, carrots, parsnips, turnips, endive, kohl rabi, rhubarb and all herbs.

POULTRY.

Cockerels for future breeding should now have been selected, and those not good enough sold for killing. It pays far better to get rid of all of the latter, even if only at 1s. or 1s. 3d. per lb., than to keep them on, eating their heads off, in the hope of getting a better price. Those good enough for breeding, and they must be good, should be kept till about June; there is a demand for such up to this month. Any surplus at this time should be eaten or sold for what they will fetch. Of those selected for breeding purposes, the owner should keep the best one or two for his own use, with another as a reserve. No poultry keeper should sell his best stock, no matter how high a price is offered for it.

By the end of this month the birds selected for breeding should be mated up. If it is possible, the birds selected for breeding should be given a run on free range for three weeks or so before being put into the breeding pen and fed sparingly; better fertility and better chicks will be the result. If it is possible to run the birds selected for breeding away from the others during the whole of the breeding season, all the better.

Any hens that become broody should be kept broody by setting a few china eggs under them until such time as eggs from the breeders come in. Broody hens at this time and for the next five months are valuable.

During the rainy season the scratching litter must be kept dry; if it gets wet it is useless.

Duck hatching can be continued all the year round; the main points are that the young ducks must be kept out of the sun and sleep on dry grass. Nothing is more fatal to ducklings than sun, and dampness at night; and the latter applies, too, to the adults. Unless a dry shed, with a drv, soft layer of chaff or sand, etc., covering the floor of it is available, it is not wise to hatch turkeys till after the wet season is finished, for it will be labour, food and eggs wasted. If the young turkeys get wet they are almost certain to die. This and the feeding on wet mashes instead of dry food, chopped onion and thick milk, are the chief reasons for non-success in the breeding of turkeys.

Vlei-Lands Make a Sand Veld Farm

1. LIME is the fairy godmother to vlei soils.
2. LIME encourages the bacteria of the soil which makes the latter productive.
3. VLEI soils must be kept sweet for maximum results.
4. LIME your vleis a year in advance of planting.
5. ACID soil mean failure.
6. A well nourished vlei pasture keeps green all the year round.
7. LIMING leads to larger yields of clover and winter crops.
8. VLEI pastures produce cheap milk.

Compost Notes

1. Improving Aeration of the Heap.
2. A Suggestion for Saving Labour in Turning.
3. Compost and the War.

By S. D. Timson, M.C., Assistant Agriculturist.

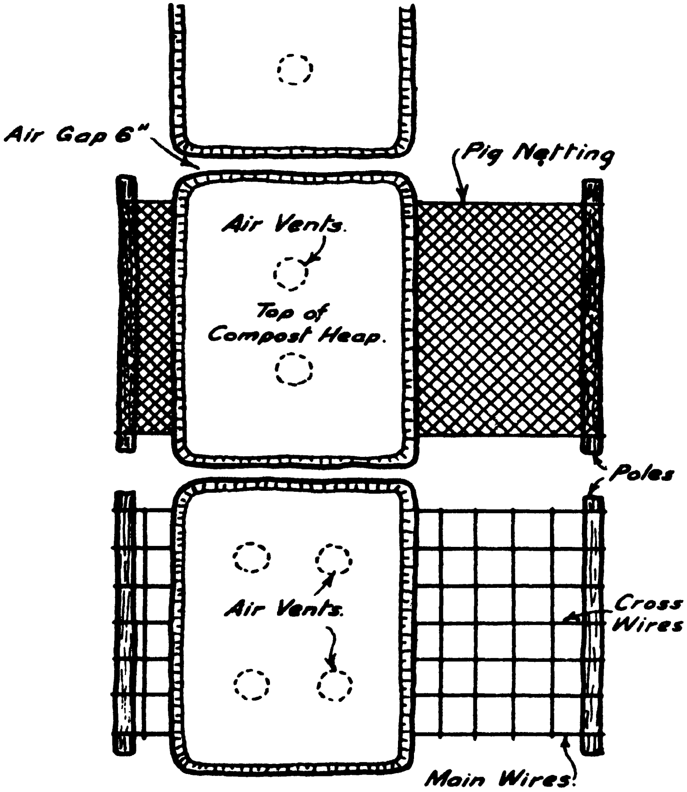
Farmers in the greater part of the Colony are again faced with unfavourable conditions for making compost owing to excessive rain.

Too much rain packs the compost heaps and prevents the entry of air, which is so essential. In extreme cases the heaps may become sodden and cold, and it is not easy to revive them when they reach this condition.

If the materials in the heaps are fine and soft, such as veld grass, weeds and maize husks, and if the season opens with a long wet period as has happened during the last three seasons, it is best to delay the first turn until a break in the rain occurs. The rain will not penetrate such heaps deeper than about 6 inches, because at that level certain microbes form a slimy waterproof film which sheds further rain; and as long as the heap is undisturbed rain cannot penetrate further.

Aids to Aeration of Heaps.—Besides the ventilation channels in the floor of the heaps or pits already recommended in the Departmental Bulletin on Compost two other simpler but very effective means of improving the ventilation can be advised as described below.

(*a*) *Sectional Air-gaps.*—When rebuilding the wide and shallow heaps at the first turn, or at any turn for that matter, leave a space of 6 inches in width, every 3-5 yards along the heap. These break the heaps up into a line of smaller heaps 3-5 yards long separated by narrow gaps, and these gaps will materially improve the aeration with no extra work (see fig.).



Sketch Illustrating the Use of
AIR GAPS AIR VENTS
and
DEVICE FOR TURNING THE HEAPS.

(*b*) *Air Vents.*—In each section of a heap or every few yards of a continuous heap, one or more air vents or chimneys may very simply be made by trusting a crowbar or pole vertically down into the heap, and then by moving the top of the bar round and round with a circular motion, a hole is made in the heap by which air can readily enter (see fig.).

Such air vents can be made, of course, at any time without disturbing the heaps and will go far to remedy, rapidly and cheaply, the bad aeration which may be due to packing of the heaps during wet periods or to other causes.

It should be borne in mind, however, that gaps and air-vents will not take the place of a proper turning of the compost heap, but are merely a valuable supplementary means of improving aeration.

Labour Saving Device.—"*Compost-turning Mats.*"—Although he has not yet been able to test it the writer considers that there are possibilities of appreciable labour saving by the simple means described below and he thinks that farmers may wish to test it without delay. The device, the use of which in compost making was suggested to the writer by Mr. J. M. Scott, who has found it valuable on a gardening scale, is one which is already well known to farmers in principle as a means of rapidly unloading bulky materials such as hay or silage from wagons.

It consists simply of two poles, which are joined together by a number of parallel wires, with cross connecting wires to prevent the main wires from spreading. Alternatively pig-netting can be used to join the poles.

The apparatus is laid on the ground on the site where a heap is to be built so that the mats of pig-netting or wire lie under the bottom of the heap, and the poles on either side. The heaps of compost are then built over them, so that the poles on one side are within a few feet of the side of the heap (see fig.). When the heap is ready for the first turn the pole nearer the heap is pegged down to the ground, and to the other a team of oxen is hitched over the top of the heap. The oxen are then driven forward and the heap of compost is rolled over sideways. This should loosen up the heap of materials, and render the rebuilding of the heap much easier.

It is hoped that this device may be of particular value where a refractory material such as the sunnhemp crop (more or less mature) is put through cattle kraals on the headlands of the field where it is grown.

After the first turn it should not be necessary to use the turning mats for the second turn, since breakdown should be sufficiently far advanced to make subsequent turning of the heaps easy.

Since the writer has not had the opportunity to test this idea for himself he is not in a position to give details regarding the best length of poles, or width of the mats, etc.; but he thinks readers may wish to try the device for themselves during the present season, and he hopes that it may prove helpful.

In order to simplify future reference to these implements it is proposed to call them "Compost-turning mats" or "Turning-mats."

Compost and the War.—If the war continues for more than a year the purchase of the necessary fertilisers, even if they are obtainable in sufficient quantities, may prove a very serious problem to the farmers of this Colony, since it would appear to be likely that a large rise in price must take place when present stocks are exhausted.

If this happens a supply of compost will be of even greater value to the farmer than it has already been proved to be by those pioneers who have been making and using it for the past three seasons. Its great value as a manure and a fertiliser has been thoroughly established during that period by many farmers all over the Colony, and for practically all the crops commonly grown in the Colony, saving only tobacco. For the latter crop its value still remains to be proved, although the limited evidence at present available goes to show that it will also be of great use to tobacco growers. Many of them are testing it out thoroughly this season, and much evidence on this important matter should be available later.

It has been used with great success on all the following crops:—Maize; vegetables and flowers; potatoes—both the summer and winter crops; wheat and barley; ground nuts; winter forage crops; lucerne; sunflowers; and on improved pastures. It has proved to be particularly effective on the poor sandy soils where dressings of only 5 tons per acre have given remarkable increases in crop yields. On soils severely infested with witchweed it has given particularly striking increases in yields of maize. Dressings of 5-10 tons per acre have been used (and higher for potatoes), and at present it would appear that dressings of 5-8 tons (10-16 cubic yards or Scotch cart loads) per acre are suitable for most farm crops. Much heavier dressings can be used with advantage, of course, on market garden crops and potatoes.

Farmers can therefore be urged to make every ton of compost they can for their own sakes, and since maximum economic production has been called for from farmers throughout the Empire in order to ensure the successful waging of the war by the Empire and our Allies, it becomes a national duty.

In this connection it may perhaps be pertinent to point out that the transport of agricultural produce from Africa as compared with their transport from countries further from Britain economises in shipping—a matter of great importance.

Dressings of well made compost at the rates suggested will supply the nitrogen and potash required for the production of high yields of all the common farm crops, save potatoes, and it will be possible by its use to materially reduce the applications of phosphatic fertilisers normally used, and still obtain high yields. During the past two seasons, for instance, the writer has seen splendid crops of maize grown on soils known to be deficient of phosphates, where dressings of compost alone were applied.

Owing to the greatly increased importance of compost as a manure due to the war, farmers are advised to consider carefully means of increasing their supplies, and the advisability of utilising the top growth of their sunnhemp and sunflower green manure crops for making compost on the lines laid down in section 3 of the Departmental Bulletin on "Compost" should receive their close attention. This method is past the experimental stage and is the cheapest way of making compost on a large scale thus far tried. Maize growers especially are urged to give the matter their careful consideration, since (*a*) they are large consumers of phosphatic fertilisers; (*b*) they grow large acreages of sunnhemp and sunflowers as green manure; and (*c*) their maize fields which are severely infested with witchweed will show greater increases in yield of maize than uninfested land, or other types of crops grown by them.

Naturally, the acreage of the crops they can handle as compost is limited by the number of stock they have available for supplying the necessary dung and urine, and as a rough indication it may be reckoned that where the cattle are kraaled at night only, one span of working oxen or their equivalent, for every 20 to 25 acres of a well grown crop of sunnhemp 6-8 feet high will be required, where the composting of the sunnhemp is carried on for the four months April to July inclusive. Working oxen will require some extra feed, during June and July at least, in the form of silage, veld hay, etc. Where the supply of pasture allows a small herd of good class native bred cows or heifers and a suitable bull may be purchased to be used for this purpose, the male progeny later being sold for slaughter. Those farmers, too, who fatten cattle, may with advantage purchase them two to four months before they commence fattening them and use them in the interim for composting, providing they ensure that the cattle lose no weight whilst so employed.

The farmer who realises the value of compost soon reaches the limit of the ordinary crop wastes available on the farm, such as maize wastes, sunflower stalks, spoilt hay and silage, and old veld grass, and he must then turn to other sources of raw materials, and the writer considers that the employment of the top growth of the green manure crop is the next logical step, particularly under war conditions.

Wheat Varieties Tested at Salisbury

By T. K. SANSOM, B.Sc., Plant Breeder.

The following selected pure lines of wheats grown at the Plant Breeding Station, Salisbury, are available for free distribution to farmers.

Applicants are requested to apply early, stating what varieties are required.

Not more than six varieties of seed can be supplied to each applicant, and the amount of seed of each variety will depend on the number of applications received for each variety.

No applications can be considered which are received after the 28th February, 1940.

1. Pusa 4.
2. Granadero Klein.
3. Kenya Governor.
4. Punjab 8 A.
5. B. 256 b.1.A. 64 (L.).
6. N.B. 230 A. 14 (L.).
7. 122 D.I.T.L.
8. 131 C.5 P.
9. Pilgrim.
10. Beltista.
11. Sabanero.
12. Kruger.
13. Reward x Early Gluyas R.T.2.
14. Reward x Wit Klein Koren C.T.1.
15. Reward x Wit Klein Koren C.T.2.

Pusa 4.—Has been grown previously in this country; it is beardless; it is susceptible to rust, but in those areas where the incidence of rust attack is not severe will yield well. It is very early maturing and makes little leaf growth, and therefore should be of use to those farmers who thresh by means of hand power.

Granadero Klein.—Is a bearded wheat which is very resistant to trust and can be recommended for those areas where Karachi becomes badly rusted; it is fairly tall growing and takes about a week longer to mature than does Karachi.

Kenya Governor.—Known also as "Somers Koren" and "90 Day Wheat," has been grown on a large scale in every district in the Colony for a good many years. It is fairly rust resistant and is early maturing, though it seems to be more susceptible to frost than other varieties. A heavier rate of seeding is required for this wheat owing to its poor tillering habit and fairly large size of grain.

Punjab 8 *A.*—Under favourable conditions this is one of the highest yielding wheats grown in the Colony; but where rust is severe it should not be grown.

B. 256 *b.*1.*A.* 64 (*L.*).—Is a beardless wheat; resistant to rust and fairly early maturing. This wheat has shown promise at the Plant Breeding Station and elsewhere. Did well in the variety trials at Umvuma in the winter of 1939.

N.B. 230 *A.* 14 (*L.*).—Is a beardless wheat; resistant to rust and fairly early maturing. This wheat has shown promise at the Plant Breeding Station and elsewhere.

122 *D.I.T.L.*—Is a beardless wheat; resistant to rust and fairly late maturing. Has done well for the past two years in the variety trials at Umvuma.

131 *C.*5 *P.*—Is a bearded wheat resistant to rust and late maturing.

Pilgrim.—Is a bearded wheat fairly resistant to rust. Has shown fair promise at the Plant Breeding Station. Shatters more than do most bearded wheats.

Beltista.—Is a bearded wheat, fairly early maturing and resistant to rust. Has shown promise at the Plant Breeding Station and elsewhere.

Sabanero.—Is a bearded wheat, resistant to rust, fairly late maturing, and tall growing. This wheat did very well in the variety trials at Umvuma.

Kruger.—Is a bearded wheat with extremely strong glumes. Is rust resistant but has a fairly weak straw when well grown. Known previously as "Bearded Non-shattering Wheat."

Reward x *Early Gluyas R.T.2.*—Is a bearded wheat, early maturing, fairly rust resistant. This is a cross between Reward and Early Gluyas and has not been grown previously on a commercial scale.

Reward x *Wit Klein Koren C.T.*1.—Is a bearded wheat with a very dense ear and exceptionally strong black awns. It is fairly rust resistant and matures a few days earlier than Karachi. This wheat is a cross between Reward and Wit Klein Koren and has not been grown previously on a commercial scale.

Reward x *Wit Klein Koren C.T.2.*—Same remarks as above, being another selection from this cross.

The following wheats are also available from the variety trials at Umvuma:—

1. 58 *F.L.I.* 2. *Renown.* 3. *Florence.*

Applications should be addressed to the Agriculturist, Department of Agriculture, P.O. Box 387, Salisbury.

CLEANLINESS AIDS INSECT CONTROL.

Type of bullock and camp used at the Matopos.

The Summer Fattening of Bullocks

Division of Animal Husbandry.

Feeding bullocks a grain ration, in addition to their grazing, is a very cheap method of fattening during the summer months where conditions are suitable.

The outlook for the present season seems very promising and it is likely that many bullocks will need only a comparatively small amount of "topping off" to make the "Imperial finish." It seems, therefore, worth while to republish briefly the data of an experiment which was carried out at the Rhodes Matopo Estate.

Thirteen 3½-year-old steers in medium condition were brought in to feed on the 23rd December. They had then got over their scouring period, changed their coats and had settled down to fill out. These steers had not been fed concentrates before and it was consequently necessary to starve them for a period before they would eat their grain ration. They were put in a feeding pen and allowed no grazing. Within five to ten days they were all feeding. They were then allowed free range in a small paddock with good grazing, shade and water, and fed concentrates each morning. Until the end of January they were fed maize only. It was noticed that the grazing was " going off " and a small amount of groundnut cake was added to the grain ration.

The average liveweight of the steers was 946 lbs. at the commencement of the feeding period. They were finished after three months of this grazing and feeding combined (89 days), and then weighed 1,171 lbs. The approximate gain for the period for 2½ lbs. per head per day, and all the steers graded "Imperial."

The fattening of these steers proved very economical. No hay or silage was used. The total amount of concentrates consumed per head was 475 lbs.

The essentials for success in this method of feeding are:

(1) *Well grown bullocks, preferably de-horned.*—Normally, for our conditions, they should not weigh much less than 1,000 lbs. liveweight when feeding starts, or be under 3-3½ years of age. It is a great advantage if the bullocks have been fed in previous winters or as weaners. They then take to feed much more readily. When the grazing is good and the bullocks are not accustomed to grain, it may be necessary to kraal them at night and feed them in the morning before they are turned out to graze. If this is not done, they may not take enough concentrates to influence their rate of gain.

(2) *A handy sized paddock, depending on the number of bullocks to be fed. This paddock should be conveniently situated and have good grazing, shade and water.*

(3) *From two to three bags of concentrates per bullock.* The amount of grain required will depend on the value of the grazing and the condition of the bullocks. The bulk of the concentrate ration should be maize, nyouti, hominy chop or a similar grain, supplemented, as the grazing goes off, by a small amount of some protein concentrate.

It is not possible to lay down any definite quantities to be fed daily. While the bullocks are making "their 2 lbs. a day or thereabouts on the veld," it is not generally economical to feed grain in addition to the natural grazing. Grain feeding should be started as soon as they begin to "hang fire" a little.

From experience the following feeding schedule is to be recommended in a normal year:—

First month (January to February).—3 to 5 lbs. of concentrates daily.

Second month and until finished.—8 to 10 lbs. of concentrates daily, including 1 lb. of groundnut cake, or its equivalent, in such feeds as beans or cotton seed.

The above schedule should be adjusted according to the condition of the steers and the feeding value of the grazing.

For further particulars write either to the Chief Animal Husbandry Officer, Department of Agriculture, Salisbury, or the Senior Animal Husbandry Officer-in-Charge, Rhodes Matopo Estate, P.B. 19K, Bulawayo.

Feeds for Poultry and How to Use Them.

(*Continued.*)

By G. H. Cooper, Assistant Poultry Officer.

MISCELLANEOUS FEEDS.

In this class we have such essentials in the diet of poultry which are not strictly feeds, but are necessary for health and production.

Oyster Shell.—Chickens growing very quickly and hens laying a considerable quantity of eggs cannot get sufficient calcium from their usual feed to satisfy their requirements, therefore additional calcium is supplied to them in various forms, one of the commonest and best being ground oyster shell. Oyster shell or a suitable substitute should be available to all poultry, and more especially laying hens, at all times. Oyster shell should contain 95% carbonate of lime.

Marine Shell.—Mixed marine shell is probably used to a larger extent than oyster shell in this country for the same purpose as it is cheaper. However, mixed marine shell as a rule does not contain as much carbonate of lime as oyster shell and may often have other impurities which may make it more expensive than good oyster shell. It is frequently mixed with grit and sold as shell grit.

Lime stone (ground) or *Agricultural Lime.*—In order to be sure that all birds are receiving adequate lime in the ration ground limestone is often added to the mash feed. This is a desirable practice. As a substitute fine oyster shell or marine shell may be used in the mash. The price and lime content of these feeds should determine which is to be used in each case. 1% of fine shell or ground limestone in the mash is desirable.

Phosphates.—Phosphorus is necessary to all poultry and must be added to the usual feed by means of a suitable supplement. The usual supplement to ensure an adequate supply of phosphorus is bone meal, which has been discussed elsewhere. Another supplement used is ground phosphate. It should be borne in mind that lime and phosphates cannot be stored or made use of by stock without the co-operation of Vitamin "D," or the ultra-violet light of direct sunlight.

Salt (common).—Common salt supplies both sodium and chlorine, which are both required in small amounts by poultry. Salt also makes a feed more palatable and aids the digestion. If consumed by poultry in too large a quantity, however, it is injurious. About ½ to 1% in the mash is considered sufficient.

Sulphur.—Frequently it is recommended that sulphur should be added to the feed of hens, and in certain treatments for blood disorders and during the moult; it is useful, however, there is sufficient sulphur in the average feed for the requirements of birds.

Charcoal.—There is no necessity to feed charcoal, but it is considered an intestinal corrective and may be fed as such. It may be included in the mash at the rate of ½% and placed in hoppers for the birds to help themselves.

Grit.—The function of grit is to act as the birds' teeth to do the crushing and grinding of feed in the gizzard. Therefore the most desirable quality in grit is its hardness. It is usual to have grit available in suitable sizes for all stock, and more especially to birds confined in intensive houses.

Condiments.—Various condiments such as mustard, pepper and proprietary articles are fed to stimulate egg production. At times they may stimulate production, but it is considered an artificial reaction and the use of stimulants is questionable. They should be used in practice with great moderation, only supplying sufficient to season the mash. They should never be fed as a regular practice.

Water.—All classes of stock require an abundant and continual supply of cool, clean, pure water, except where skim milk is fed as the sole protein supplement to the grains when it furnishes the water requirements. Where there is any doubt about the purity of the water it should be tested for impurities. The water must be kept out of the sun and in clean vessels. It must be renewed at least once daily. In severe cold weather tepid water should be given.

HOW TO USE THE FEEDS.

Having discussed the various feeds available for poultry in this country the next step is for the farmer to know how to use them in order to produce the desired result. It must be emphasised here that there is no one best ration applicable to all farmers. The best ration for each individual farmer is that which produces the best results at the minimum cost of production on his farm.

Success in poultry feeding depends primarily upon:—

1. The individual responsible for the feeding and his powers of observation. Native labour, unless well trained and experienced, should not be relied upon for this most important work without frequent supervision.
2. The quality of the food supplied.
3. What is termed a "balanced" ration.
4. The environment allowing the birds to make the best use of the supplied food.
5. The health, vigour and heredity of the stock.

Maintenance.—Before egg production, growth or fat can be provided the bare maintenance of the bird must be fully satisfied. About three-quarter of the feed taken in is for this purpose and only a surplus goes to the extras. Maintenance requirements are for heat, energy and repairs to the body tissues, etc. Where a ration is inadequate, production and not maintenance is the first to suffer, as self-preservation is the first law of nature. Feeders of all classes of stock would do well to bear this fact in mind. No profit comes directly from the maintenance of the body, but unless it is satisfied no profit can be expected from the little extra which goes to form eggs or meat.

Definition of Terms.—In order to understand how to furnish the feeds in the correct proportions it is necessary to know something about their composition and digestibility. This is supplied in the accompanying table and refers to the amount of digestible nutrients available in the various feeds as far as poultry are concerned.

A balanced ration is one that consists of the proper nutrients in the right amounts for the purposes intended.

A nutrient is any constituent of a feed that produces heat and energy or builds body tissue.

Feeds are composed of water and dry matter, but not sufficient water for the body needs, therefore it must be supplied. Dry matter is composed of organic and inorganic substances. The organic material is combustible and consists of sugars, starch, fat, protein and fibre. The inorganic substance is composed of minerals and ash.

The protein is chiefly concerned in the making of lean meat, nerves and feathers in the fowl and the albumen or white of the egg. It is essential for egg production and growth. No nutrient will take its place, and it is generally the most expensive part of the feed.

The source of the protein is of importance in balancing the cereal grains which make up for the most part the carbohydrates in the feed. However, it is not the protein that is of such importance but the amino-acids composing it. A vegetable protein is no less and no more valuable than an animal protein carrying the same amino-acids. It has been shown that protein from vegetable sources carrying the correct amino-acids could partly or wholly replace animal protein in the ration when supplemented with minerals.

Therefore, whether vegetable protein supplements should be used partially to replace animal protein supplements will depend upon the relative prices of the digestible proteins. The emphasis as to source of the protein should not be made as between animals and vegetable but between grain and other sources.

Other factors, however, influence the selection of the protein supplement, and as supplements of animal origin such as milk products, meat and fish products, are more palatable and add variety to the ration, a proportion of one of them in the ration is usually recommended. As mentioned elsewhere the vegetable sources of protein carrying the desirable amino-acids in this country are chiefly peanut meals, soya bean meals or other legumes.

Carbohydrates include the fibre and nitrogen-free extract. The fibre is the woody or cellulose portion of plants, this the fowl can only digest to a minor degree, but a certain amount is necessary to distend the intestines and allow the digestive juices to act more thoroughly. Nitrogen free extract consists mainly of the starches and sugars and is used by the fowl to supply heat and energy, any excess being stored as fat.

Fat has the same function as nitrogen free extract, but is however more effective than starch or sugars and gives 2¼ times as much energy for each unit of weight. Digestible nutrient refers to the amount of any of the feed substances that can be assimilated by the class of stock concerned. Poultry differ somewhat from ruminants in their ability to digest these nutrients. The digestible co-efficient of any food nutrient can only be found by actual trial, and with poultry this is difficult owing to the urine and faeces being mixed before expulsion. However, a certain amount of work has been done with poultry in Europe and U.S.A. and digestible co-efficients arrived at for the more important feeds. These have been used as far as possible, together with Rhodesian or South African analyses of feeds where available, in order to compile the "table of feeds." Where no co-efficients of digestibility are available those for a similar feed or those for other classes of stock have been taken and are as near as possible correct until more work is done on this important subject with poultry.

The nutritive ratio means the amount of digestible protein in the feed or ration as compared with the combined digestible carbohydrates and fat. A nutritive ratio (or N.R.) of 1 to 5 (or 1 : 5) means that the feed or ration contains one part of digestible protein to every five parts of digestible carbohydrates and fat.

The total digestible nutrient (or T.D.N.) is found by multiplying the digestible fat in the feed by 2¼ and adding this to the digestible carbohydrates (or nitrogen-free extract) digestible protein and digestible fibre if any in the feed.

Standard Requirements.—No very detailed standards of requirements are available for poultry as there are for other classes of farm animals, but from studying the results of successful rations the following standard requirements are considered to be fairly accurate.

Growing Chicken to 12 Weeks.—Fibre 4 to 6 per cent. of total food consumed. Digestible protein 15-18 per cent. of the total food consumed, of which 4-5 per cent. should be animal protein.

Total digestible nutriment 70-75 per cent. Here the nutritive ratio is 1:3 to 1:4.

Laying Hens and Chickens after 12 Weeks of Age.—Fibre 4 to 6 per cent. of total food consumed. Digestible protein 12 to 15 per cent., of which 3 to 4 per cent. should be animal protein.

Total digestible nutriment 70 to 75 per cent. Here the nutritive ratio is 1:4 to 1:5.

Fattening Birds.—Fibre 3 to 5 per cent. of total food consumed. Digestible protein 10 to 12 per cent., of which 3 to 4 per cent. should be animal protein.

Total digestible nutriment 75 to 80 per cent. Here the nutritive ratio is 1:6 to 1:7.

Rations must be compiled to conform as nearly as possible to the standard requirements as given which, of course, include maintenance. It must be emphasised that these requiremnets are a guide only and other feed factors must be considered before a ration which may conform to the requirements theoretically could be considered desirable. The feed factors to be considered further are:—

Variety.—A variety of feed is necessary to stimulate the appetite and increase the consumption, though sudden changes in feed are not desirable. Where nearly equal parts of grain and mash are fed a ration containing a good variety may be made up somewhat as follows:—

	Per cent.
Grain, at least two kinds	40
Ground feeds, at least three kinds	35
Animal feeds, one kind usually desirable	5
Green feeds, as large a variety as possible	15
Minerals, grit and shell	5

Palatability.—Feeds that are not palatable to poultry must not be fed to any extent. At times they can be mixed with other feeds in the mash. Feeds that are unpalatable have been mentioned under the discussion of the feedstuffs.

Wholesomeness.—Only sound, sweet feed should be utilised. Decayed or musty feeds may cause serious trouble.

Mechanical Condition.—The feed must not be too bulky or the birds will not be able to consume sufficient. If the fibre requirements are adhered to the ration should be correct in this respect. Glutinous feeds must not form too large a percentage of the mash, as they become sticky when mixed with water or the digestive juices and are not readily consumed.

Medicinal Effect.—Some feeds are laxative, notably the oil meals and wheaten bran.

Availability.—Home grown feeds should be used as far as possible. Some which alone are not satisfactory may be combined with other feeds to form a desirable ration.

Cost.—In all cases the best feed is the one that gives the most economical return, and all feeds should be considered from this viewpoint. Sickness and mortality due to improper diet must be reckoned against the cost of such diet.

Effect on Product.—Some feeds taint the eggs or flesh of the birds; they should be avoided as far as possible. These feeds are mentioned previously.

Vitamins.—The vitamins are of great importance in poultry feeding. Briefly, to be fairly safe in this respect it is only necessary to feed some succulent green feed or dried green feed to ensure ample Vitamin "A" in the ration. Allow all stock ample access to direct sunlight to enable them to receive ultra-violet light as a substitute for Vitamin "D." Luckily this is easily fulfilled in this country. If these two points are adhered to there should be no trouble from vitamin deficiencies. For a fuller description of the vitamins as they affect poultry feeding see Bulletin No. 884, Department of Agriculture, "The Vitamins in Poultry Feeding."

Computing Rations.—As an example the following laying ration has been worked out, using the table of feeds provided.

Referring to the table it is seen that 100 lbs. of wheaten bran contains 9.5 lbs. of fibre, 11.5 lbs. of digestible protein and 39.8 lbs. of total digestible nutriment. In a similar fashion each feed is worked out according to the amount in the ration.

When equal parts of grain and mash are fed the totals of 100 lbs. of each must be divided by two to find the amounts in 100 lbs. of the complete ration.

The mineral mixture in this ration consisted of 50 lbs. bone meal, 20 lbs. fine salt, 20 lbs. fine marine shell, 10 lbs. of fine charcoal, of which 10 lbs. was added. As the bone meal is the only ingredient carrying food nutrients required, the amount for the minerals is calculated on 5 lbs. of bone meal being 50% of the 10 lbs. of minerals.

	Fibre.	Digestible Protein.	Total Digestible Nutriment (T.D.N.)
Mash Mixture—			
100 lbs. Wheaten Bran	9.5	11.5	39.8
200 lbs. Pollard	9.4	29.2	151.0
100 lbs. Maize Meal	2.3	6.9	78.9
50 lbs. Fish or Meat Meal	—	28.0	36.3
35 lbs. Lucerne Meal	10.5	3.5	5.8
15 lbs. Peanut Cake Meal	.6	6.0	12.5
10 lbs. Minerals (50% Bonemeal)	—	1.1	1.4
500 lbs. Mash	32.3	86.2	325.7
100 lbs. Mash	6.4	17.2	65.1

Grain Mixture—			
300 lbs. Cracked Maize......	6.0	22.2	239.4
150 lbs. Munga (Nyouti)	11.7	12.6	116.1
50 lbs. Sunflower Seed	13.9	6.7	37.1
500 lbs. Grain......	31.6	41.5	392.6
100 lbs. Grain......	6.3	8.3	78.5
add 100 lbs. Mash	6.4	17.2	65.1
200 lbs. Ration	12.7	25.5	143.6
100 lbs. Ration	6.3	12.7	71.8

Succulent green feed, though it contains digestible nutrients, is not as a rule taken into consideration in these calculations.

This ration then has 6.3 lbs. of fibre, 12.7 lbs. of digestible protein and 71.8 lbs. of T.D.N. for every 100 lbs. of feed.

The nutritive ratio is computed by substracting the digestible protein from the T.D.N., thus: 71.8—12.7=59.1. This figure (59.1) therefore represents the digestible carbohydrates and fat. Dividing by the digestible protein (12.7) gives the nutritive ration (4.6) thus: $\frac{59.1}{12.7}=4.6$. The nutritive ratio of the ration is, therefore, expressed as 1:4.6.

From the above it will be seen that this ration conforms closely to the standard requirements for laying hens given previously and may therefore be accepted as theoretically correct. As it also possesses palatability, variety, vitamins, minerals and available feeds, it may be considered complete and a balanced ration, for egg production, preferably fed in conjunction with succulent green food and, of course, water, shell, grit.

If in calculating the ration the nutritive ratio is found to be too wide for the purpose, that is to say, it contains more carbohydrates and fat to each part of protein than desirable, the amounts of one or more feeds that have wide nutritive ratios should be reduced and one or more feeds that have narrow ratios (containing a large proportion of protein) should be substituted. If on the other hand the nutritive ratio is found to be too narrow, that is, containing less carbohydrates and fat to each part of protein than desirable, the amount of one or more feeds having narrow nutritive ratios should be reduced and one or more feeds having wider nutritive ratios should be substituted. In this way after a few trials it should be possible to form a ration that will contain all the food nutrients in proper proportion and amounts for the particular class of stock to be fed.

Table of Feeds showing the Average Digestible Composition per 100 *lbs. of Feed for Poultry.*

Feed.	Total crude fibre. pounds.	Digestible crude protein. pounds.	Total Digestible nutriment. pounds.	Nutritive ratio 1:
Barley	4.6	8.7	71.0	7.16
Bean meal	9.4	20.5	75.6	2.9
Buckwheat	10.1	6.1	63.4	9.39
Buckwheat middlings	4.8	24.6	75.0	2.0
Cottonseed meal	11.5	27.6	67.5	1.45
Cowpeas	4.1	19.4	76.4	2.9
Gluten feed	7.1	21.6	75.4	2.5
Hominy feed	8.5	6.3	76.5	11.1
Kaffir corn	2.3	7.6	76.7	9.09
Maize, whole	1.8	8.4	80.6	8.6
Maize, cracked	2.0	7.4	79.8	9.78
Maize meal	2.3	6.9	78.9	10.43
Maize and cob meal (corn and cob)	8.5	6.3	76.5	11.1
Maize germ meal	2.0	9.1	88.2	9.2
Millet, pearl (N'youti or munga)	1.6	9.0	78.5	7.7
Milo	2.4	8.7	79.9	8.2
Oats	10.1	9.8	62.9	5.42
Oatmeal	9.9	9.0	58.1	5.5
Pea, field	5.6	20.2	90.5	3.48
Peanut meal with shell (not extracted)	12.5	17.1	93.6	4.47
Peanut meal (kernels)	2.5	29.4	133.9	3.5
Peanut meal extracted (unshelled nuts)	4.5	40.3	83.5	1.1

Feed.	Total crude fibre. pounds.	Digestible crude protein. pounds.	Total Digestible nutriment. pounds.	Nutritive ratio 1:
Pollard	4.7	14.6	75.5	4.0
Rice	9.6	5.7	62.0	9.88
Soya bean meal (not extracted)	4.3	33.2	94.1	1.8
Soya bean meal (extracted)	5.5	34.7	72.5	1.09
Sunflower seeds	27.9	13.5	74.3	4.5
Sunflower head meal (no seeds)	14.19	6.86	60.4	7.4
Sunflower head meal (with seeds)	20.52	10.25	72.96	6.3
Wheat	2.2	8.7	73.5	7.45
Wheat bran	9.5	11.5	39.8	2.46
Wheat feed	7.6	12.9	64.2	4.0
Wheat screenings	7.4	9.6	62.3	5.5
Blood meal	—	72.6	76.8	0.06
Blood (dried or fresh)	—	62.10	97.07	0.5
Bone meal	—	22.6	29.4	0.3
Bone, fresh cut	—	18.3	73.4	3.0
Buttermilk	—	3.4	8.4	1.5
Crayfish meal	—	36.0	62.4	0.6
Fish meal	—	56.1	72.6	0.4
Locust meal	10.81	44.47	93.9	1.0
Meat meal (high grade)	—	54.2	78.0	0.44
Meat meal (50% protein)	—	46.2	70.0	0.5
Meat and bone meal	2.1	36.6	64.2	0.7
Meat, fresh	—	18.5	26.6	0.4
Meat, dried	—	60.2	92.3	0.4
Milk, separated	—	3.6	9.2	1.6
Whey	—	0.8	6.2	7.8
Succulent Green Feeds, Roots, etc.				
Cabbage	0.9	1.9	7.1	2.7
Cactus, spineless	2.3	0.4	9.7	23.2
Carrots	1.2	1.9	7.2	2.5
Lucerne	7.0	3.3	11.7	2.5
Mangels	0.8	0.8	6.7	7.4
Melon, cattle (majorda)	1.4	0.3	4.8	15.0

Feed.	Total crude fibre. pounds.	Digestible crude protein. pounds.	Total Digestible nutriment. pounds.	Nutritive ratio 1:
Oats, green	1.7	3.4	7.5	1.2
Oats, sprouts	3.7	2.4	15.8	5.6
Potato	0.4	1.0	15.7	14.7
Pumpkin	1.3	1.1	6.7	5.1
Rape	2.6	2.6	11,0	3.2
Sunflower leaf	1.97	3.12	14.2	3.4
Swiss chard or spinach beet	2.9	3.1	7.1	1.2
Dry Leaf Meals.				
Lucerne meal	30.1	10.2	16.8	0.6
Sunflower leaf meal	7.87	12.5	26.6	1.2

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Bugs and beetles take their toll
but
Cleanliness Aids Insect Control.

Nineteenth Annual Report

DIVISION OF FORESTRY FOR THE YEAR 1938.

(*Continued.*)

By E. J. Kelly Edwards, M.A., Dip. For. (Oxon.),
Conservator of Forests.

II. MANAGEMENT OF STATE FORESTS.

1. **Regulation and Management.**—(*a*) *Annual Plans of Operation.*—Plans for the year's work, April, 1938-March, 1939, were submitted for each station and approved. It appears probable that these will be fairly closely adhered to both at Stapleford and in the Kalahari Sands. The position at Mtao has, however, been materially altered owing both to fairly severe losses in newly-planted areas as a result of the early cessation of rains at the beginning of the year, and to the fact that some of the land to be prepared for the present season's planting proved more difficult and expensive than had been anticipated.

It is therefore probable that the area set down for planting will not be completed.

(*b*) *Enumeration Surveys.*—The major work for the year was again enumeration surveys and very good progress was made both in the Kalahari Sand Forests and at Mtao Forest Reserve.

In the former area the enumeration of Gwaai Forest Reserve was completed and it was clearly seen that the fire control measures carried out during past years, in cut-over areas, have been successful even to the extent that areas of Umgusu are spreading.

Reconnaissance surveys on a 2¾% basis were also made in the native areas bounded by the Gwaai River on the west and north-west, the Gwampa River in the north as far east as Lake Alice and Pioneer blocks on the south and south-east. Some valuable areas of Umgusu were revealed as a result of this survey.

In the Inseze Forest Reserve, provisionally reserved last year, a similar survey was carried out. This area proved to be disappointing, there being a marked deficiency of the smaller size classes and regeneration.

In the Sikumi area, north-west of the Ngamo Forest Reserve, little of any value was discovered in spite of the fact that a few years ago large quantities of valuable timber were extracted. The poor results were due to severe fire damage for some years following exploitation.

At the close of the year a survey of Bembesi Forest Reserve was in progress on a 5½% basis.

The total area thus surveyed amounts to 500,000 acres of forest, approximately half of which contains exploitable or exploited Umgusu forest. It is expected that the co-ordination of the surveys will be completed during the coming year.

At Mtao an enumeration survey of 1,031 acres of plantation on a 3½% basis was carried out, but the data collected have not been co-ordinated.

2. **Protection.**—(*a*) *General.*—All forest areas were regularly patrolled by rangers and forest guards.

(*b*) *Protection against Fire.*—151 miles of fire-line were maintained at Stapleford and 139 miles at Mtao Forest Reserve, while 182 miles were burnt on the Gwaai and Ngamo Forest Reserves.

In addition controlled burning was undertaken on a large scale in the latter two areas. The term implies the early and light burning of areas in such a way as to reduce the debris but to do no appreciable damage to the forest.

It is necessary, in order to do this, to have a clear idea of the state of the forest, since areas where young regeneration is abundant must be avoided and kept free of fire.

Periodical controlled burning, carried out in such a way as to burn off dead material only, is considered to be preferable to the risks involved in complete protection which, if successfully obtained over a long period, involves the accumulation of so much inflammable material that a fire gaining access does untold damage.

While it is impossible to give accurate figures as to the area treated by this method, it is considered that approximately 80,000 acres were covered. Results were, on the whole, satisfactory, but while in one limited area the fire obtained was too fierce, owing to the forest floor carrying a heavy crop of grass, in the majority of areas it was not sufficiently fierce. Nevertheless, much valuable information has been gained and in future years it will no doubt prove possible to improve the technique very considerably. Meanwhile plots have been laid down in the treated areas and the effects of this operation are being carefully noted.

It is noteworthy that all Stations, in addition to the Forest Officer attached to the Native Department, have commented on the reduced number of fires in the districts, which is attributed to the publicity given during the year to the prevention of this menace.

(*c*) *Forest Fires.*—In the Kalahari Sand Forests only one fire, covering approximately 5,000 acres, occurred. This was caused by one of the native staff who attempted to improve on control burning operations. The majority of the area was of little value, but approximately 500 acres of Umgusu in the pole stage received a sharp set-back. The area burnt is equivalent to 0.84% of the 590,500 acres protected.

An extensive fire occurred in the unprotected Masue Forest, but fortunately the wind changed and the damage caused was not very great. A fair amount of regeneration was destroyed, but it is considered that this was at least partially beneficial and acted as a preliminary thinning.

Two fires occurred in the Mtao Forest Reserve, totalling 140 acres. These fortunately occurred in indigenous bush and no damage was caused to plantations.

At Stapleford a fire caused by lightning burnt 1¼ acres of two-year-old *Pinus longifolia*. Labour was quickly on the spot and, aided by a heavy fall of rain, it was quickly extinguished.

A further fire, covering 2,500 acres, occurred in the low-veld savannah country occupied by native tenants.

(*d*) *Against Animals.*—Baboons as usual damaged Mchibi (*Copaifera coleosperma*) trees in their search for seed, tearing down branches to get at the pods.

Spring hares continued to eat off young plants at Mtao Forest Reserve and were barely kept in check by shooting.

A certain amount of rat damage was noted at Stapleford, more especially in *Pinus patula* and *Pinus caribaea.* Trapping was resorted to and a large number were captured, but the removal of the cover favoured by these animals is the most satisfactory method of control.

Small buck are also responsible for a certain amount of damage on this Station.

(*e*) *Against Insects.*—A stand of *Eucalyptus microcorys* at Mtao Forest Reserve, reported on last year as being unhealthy and harbouring *Phoracantha semipunctata,* has now been felled. No further damage by the insect has been recorded.

During August and September, locusts were responsible for a certain amount of defoliation at Stapleford, where they remained for several days. The chief species attacked were *Pinus radiata* and *Pinus insularis.* In the case of the latter species the bark of young shoots was also attacked. By the end of the year, however, few traces of this damage remained.

(*f*) *Against Natural Causes.*—The early cessation of the rains at the end of January caused considerable losses in young plants both at Stapleford and Mtao.

No frost damage was noted on these Stations, but in the Kalahari Sand Forests young shoots of exploitable species were cut back along forest fringes and in frost hollows.

III. SILVICULTURE.

(a) **Natural Production.**—*Indigenous Forests.*—Umgusu had a very light seed crop, but as seed can lie dormant for a number of years the heavy rains now being experienced should have beneficial results on natural regeneration. The effects of protection were again noted and areas which had an apparently stagnant crop of seedlings and young trees 2 ft.- 5 ft. in height are now rapidly coming away and developing young and healthy pole crops.

Other exploitable species in the Kalahari Sand Forests also produced light crops.

At Stapleford certain eucalypt plantations are being invaded, notably with such indigenous mountain forest species as *Macaranga mellifera, Cussonia umbellifera* and *Polyscias malosana.*

Exotic Trees.—Natural regeneration of *Pinus patula, Cupressus lusitanica, Acacaia mollissima, Acacia melanoxlon* and various eucalypts was noted at Stapleford and Inyanga. The spread of an old cattle shelter of *Eucalyptus botryoides* in ploughed land at Stapleford was noted to have been 80 feet against the prevailing wind and 195 feet down wind.

(b) **Artificial Production.**—*Plantations.*—The total area afforested during the year was 770.45 acres as shown in the following table which takes into account adjustments brought about by re-surveys and failures of previously planted areas.

Station	Type.	Acres. Adjusted total area afforested as at 31.12.1937.	Acres. Area planted during 1938.	Acres. Total area afforested as at 31.12.1938.
Mtao Forest Reserve	Conifers	949.89	58.86	1,008.75
	Broadleaved	1,063.62	102.89	1,166.51
	Totals	2,013.51	161.75	2,175.26
Stapleford Forest Reserve	Conifers	4,277.80	579.20	4,857.00
	Broadleaved	158.30	29.50	187.80
	Totals	4,436.10	608.70	5.044.80
Salisbury Forest Nursery	Conifers	6.21	—	6.21
	Broadleaved	48.79	—	48.79
	Totals	55.00	—	55.00
	Grand Totals	6,504.61	770.45	7,275.06

(c) **Nurseries.**—The usual nurseries were maintained.

At the Forest Nursery in Salisbury from which supplies of trees and shrubs are distributed to the general public, a record year was experienced and over 300,000 plants were issued. In addition 67,000 trees and shrubs were issued free to Government Stations. These numbers might have been substantially increased had it not been for the shortage of tins. This has indeed become a serious problem due to the almost universal use of petrol pumps and the importation of petrol in bulk from Beira. It became necessary to purchase tin plates at very considerable cost and to make these up into planting trays.

A considerable change in the layout of the nursery was undertaken and a new area was opened in close proximity to the office for the display of available plants. As a result both the staff and the public were saved considerable time hitherto expended in walking to the main nursery.

Four nurseries were maintained on the Stapleford Forest Reserve and these supplied the plants required on the Reserve. Cutworms were less in evidence than usual.

Experiments were continued with seed of local indigenous species and germination has on the whole been good.

On the Mtao Forest Reserve the Chaka nursery, manned by elderly Europeans, supplied the requirements of the Reserve. These men are paid from the votes of the Department of Internal Affairs and transplants valued at the cost of production by native labour are paid for by this Division into the funds of that Department.

Damping off was very prevalent among coniferous seedlings, *Pinus palustris* and *Pinus caribaea* suffering particularly.

Treatment of seed-beds with commercial sulphuric acid, at the rate of 1 fluid ounce to 1 gallon of water, appears to be successful if applied in time. Affected tins of seedlings are treated with Cheshunt Compound.

A new water tank is in course of erection, and when completed should greatly facilitate the work at the nursery.

Nursery and planting operations for the two forest stations were considerably handicapped by the loss in transit of an important consignment of conifer seed from America.

(d) **Operations for the Improvement of Growing Stock.**—At Mtao and Stapleford all plantations requiring weeding and cultivation were tended and 823 acres were blanked during the year.

Selective first pruning of coniferous plantations at Stapleford was commenced and 10 acres were treated to a height of six feet at a cost of 6s. 3d. per acre.

At Mtao 57 acres of eucalypts were thinned lightly for the production of poles for sale.

At both Stations experimental thinning plots in *Pinus radiata* stands were treated with varying intensities. The habit of growth of this tree between the seventh and tenth year of age, in stands planted with 6 feet by 6 feet espacement, points to the desirability of early and frequent light thinnings, on account of a tendency of the trees to lean and bow at a particular stage of growth.

(e) **Silvicultural Notes.**—It is understood that in certain African territories difficulty is obtained in the successful raising of *Pterocarpus angolensis* from seed mainly on account of the cost of extracting the seed from the bristly pod.

At Mtao Nursery it was found that pods collected fresh from the tree and given ordinary nursery treatment achieved 18% germination within three months of sowing.

Of recent introductions *Pinus insularis* shows considerable promise at both Stapleford and Mtao.

Mimosa bracatinga, after two years of rapid growth at Stapleford, have made little headway during the past year, while at Mtao and the Salisbury Nursery they have succumbed almost entirely from drought during the same period.

(f) **Experiments.**—*Eucalypt Coppice.*—An experiment was initiated at Mtao to obtain data as to the dependence of coppice growth on time of felling and size and vigour of the trees felled. The area chosen comprises a stand of mixed *Eucalyptus rostrata*, *E. tereticornis* and *E. punctata*. Plots of equal size are being clear felled each month.

Resin.—Observations were made over a period of 36 weeks on the tapping of resin carried out weekly on a selected series of trees of *Pinus caribaea*, *P. pinaster*, *P. radiata*, *P. Patula* and *P. taeda*.

Forty-five trees varying in diameter from 3 to 7 inches of each of these species yielded in the order named 12 lbs. 12 ozs., 7 lbs. 12 ozs., 7 lbs., 4 lbs. 5 ozs. and 3 lbs. 5 ozs.

Match Boxes.—Small quantities of *Pinus patula* and *Pinus radiata* for the making of match boxes were tested by the local match factory. The results justify further trials on a larger scale. Of indigenous trees the sapwood of *Pterocarpus angolensis* proved unsatisfactory and *Lannea discolor* needs further trial.

(g) **Herbarium.**—The collection of botanical specimens was continued as opportunity offered and 147 specimens were forwarded to the Imperial Forestry Institute, Oxford, for identification. Eighty-one identifications were received and 72 mounted specimens, including no less than 14 new genera, were added to the Herbarium.

A considerable number of specimens was received from members of the public, the majority of which it was possible to identify by comparison with Herbarium material.

IV. EXPLOITATION.

(a) **Indigenous Forests.**—There was no exploitation of reserved or unreserved State forests during the year, and work was confined to the exploitation of umgusu in the new Concession in the Gwaai Native Reserve and to a small area of Crown land in the Nyamandhlovu district. Owing to the fact that royalty is paid six months in arrear the revenue received for exploitation on Crown land does not truly reflect the reduction in cutting.

A commencement was made with the use of lorries in these areas in order to exploit small patches of forest which do not warrant the expense of laying narrow gauge railway extraction lines. It is reported that although the economic value of these has not yet been proved, they were extremely useful in keeping mills fully supplied. Mechanical loaders were also brought into operation and promise to bring about considerable economies at the depots in the forest besides very materially reducing the labour force required.

It is considered that further improvement in percentage recovery has been obtained and more attention was given to the examination of logs and their better utilisation.

(b) **Exotic Forests.**—No exploitation took place at Stapleford except for the thinning of small plots for experimental purposes. Plantations, however, are now rapidly reaching the stage where thinning is becoming a necessity, and plans are in hand for a considerable programme during the coming year.

Sales of eucalypt poles showed a decrease at Mtao where only 13,074 cubic feet were disposed of as compared with 20,083 cubic feet during the previous year.

This is attributed largely to a decrease in the erection of large buildings in Matabeleland, for which a large number of scaffold poles were required in the previous year. There was, however, an increase in the sale of timber for mining purposes compared with the previous year.

V. IMPORTS AND EXPORTS.

(a) **Imports.**—Information given by the Department of Statistics shows that the value of imports belonging to Class X., "wood, cane, wicker and manufactures thereof," amounted to £305,381 for the year 1937, an increase of £100,839 over the previous year.

Certain of these imports were re-exported, and by taking into account the difference between the f.o.b. values of imports and the local value of re-exports it is estimated that the value of *nett* imports for 1937 was £298,000, or £97,000 more than the previous year.

The quantities of all classes of wood and wood products are not recorded, but a conservative estimate shows that the nett imports of softwoods during 1937 amounted to 1,272,000 cubic feet valued at £110,000.

(b) **Exports.**—The value of exports for the year 1937 was £149,850, of which £128,456 represented the produce of Southern Rhodesia. Total exports increased by £21,890 over the previous year.

VI. COMMUNICATIONS AND BUILDINGS.

(a) **Roads and Paths.**—Further road work was carried out at Stapleford and approximately two miles were completed, while existing roads were maintained and improved. Over five miles of graded paths were also constructed.

Roads were kept in repair at Mtao, some of the more important being treated with a grader kindly loaned by the Roads Department.

In the Gwaai Forest Reserve a new road up the Insuza vlei was completed, while in the Ngamo Forest Reserve 30.5 miles of road were constructed, thus considerably opening up the area.

All roads were maintained, but the cartage of bitumen from Gwaai Siding through the reserve to the main Victoria Falls-Bulawayo road has done very extensive damage. The Roads Department lent a gang of 22 natives for a period of two months for repair work, but in spite of good work it is doubtful whether these tracks, on which the sand has been permanently loosened, will ever recover.

(b) **Buildings.**—New quarters were erected for the Forester in the Fairfield patrol at Mtao Forest Reserve, together with a new office. This work was carried out by the Public Works Department.

The rooms occupied by the European labourers at the Chaka Nurseries were improved by the addition of composition board ceilings.

The Forester's quarters in the Gwaai Forest Reserve were re-roofed and minor repairs and additions were made to the quarters in the Stapleford Forest Reserve.

VII. REVENUE AND EXPENDITURE.

The following statements, unaudited, exclude revenue and expenditure in connection with relief of European unemployment, and Native Reserves.

Revenue.

	£	s.	d.
Royalties on indigenous timber	£3,227	0	7
Plantation produce	506	6	2
Seeds and transplants	2,907	13	3
Sundry	86	15	4
Total	£6,727	15	4

This figure is a decrease of £731 12s. 7d. compared with the previous year.

Expenditure.

	£	s.	d.
Salaries and Allowances	£10,066	7	6
Travelling and transport	675	8	11
Office and miscellaneous expenses	409	9	9
Afforestation and protection	6,308	17	4
Game Reserves and National Parks, exclusive of Rhodes Inyanga Estate	2,555	15	5
Total	£20,015	18	11

VIII. ADMINISTRATION.

(a) **Permanent Staff.**—The Division was considerably handicapped by lack of staff during the year, caused by resignations, illness and secondments. The Curator, Victoria Falls, was absent for over three months on sick leave, his duties being performed by the Forester, Fuller-Masue. The Forester in charge of Mtao was also absent for a period totalling three months, necessitating the transfer of a Forester from the Kalahari Sands.

The Manager of the Rhodes Inyanga Estate was relieved, when absent, by a Forester from Ngamo Forest, and this relief was extended to a total of eight months owing to illness and other causes.

Two learners resigned during the year and one Forester tendered his resignation which will take effect early in the new year.

Two Learner-Foresters were recruited during the year and a new appointment of Assistant to the Game Warden was filled.

Mr. Finlay, District Forest Officer, who was absent on vacation leave for five and a half months, was granted six weeks' study leave during which he visited forests belonging to the Forestry Commission in the United Kingdom and attended the Imperial Forestry Institute at Oxford.

At the end of the year the staff consisted of the Conservator of Forests, five District Forest Officers, eight Foresters, one Foreman-Forester, three Learner Foresters, the Manager, Forest Nursery, a Game Warden and Assistant Game Warden, the Curator, Victoria Falls, the Manager, Rhodes Inyanga Estate, and a clerk—total 24.

(b) **Temporary Staff.**—The native labour staff employed during the year averaged 417.

(c) **Private Forests.**—During the year an address was given to one Farmers' Association. Thirty-five farms or estates were visited and advice given on general tree planting.

Much of the time of the staff and Head Office was given to advisory work, both by interviews and by correspondence.

Exhibits were staged at the Salisbury and Umtali Agricultural Shows.

The latest figures available show that the recorded extent of private plantations at the end of 1937 was 20,716 acres.

IX. GAME RESERVES AND NATIONAL PARKS.

1. **Wankie Game Reserve.**—The appointment of an Assistant Game Warden during the year enabled inspections and patrols to be carried out more frequently and further reconnaissances of unknown portions of the reserve were carried out.

The staff of eight native rangers, who are trained as special constables and some of whom are accompanied by

Bushmen guides, maintained complete boundary patrols covering 19,000 miles. Very few cases of poaching occurred.

A portion of the south-eastern boundary previously undefined was demarcated.

A notable achievement was the settling of the vexed question of prospecting for minerals. As a result of an inspection by a geologist all but a small mineralised portion in the north-eastern corner of the reserve is now closed to prospecting, much of which in the past was not of a *bona fide* nature.

The improvement of water supplies in the more developed northern portion was continued by the construction of three dams by the Irrigation Department.

The value of the system of augmenting semi-permanent natural pans by water from nearby boreholes may now be considered as proven, as the pans so assisted carried water for game throughout a bad dry season.

Four new rest huts for the accommodation of visitors were erected near the Game Warden's headquarters.

An additional thirty miles of road were partially completed and the existing 177 miles were kept open during the dry weather. Portions of these, where the ground traversed is exceedingly sandy, were surfaced and this work was greatly facilitated by the provision of a two-ton lorry.

The northern portion of the Reserve in which all development has hitherto taken place had a favourable season for the animals, and there has been a fair increase in numbers. The natural water supplies in this region dried up towards the end of the season, but water was always obtainable in the "pans," or natural ponds where windmills have been erected.

In the southern portion of the Reserve conditions were much less favourable and the mortality was in some cases severe. This must be deplored, for although the intention is to leave this area as a true sanctuary for game uninfluenced by man, it must become to a certain extent a reservoir for the more developed area in the north.

Game.—The numbers of *buffalo* did not change perceptibly, but calves have done well during the season.

Eland.—Eland have been fairly widespread, but the number of calves appear to be less than usual.

Elephant.—The main herds kept to the south of Shakawinki. Seepage springs towards the end of the dry season were insufficient for their requirements in this area and there was considerable fighting for water. In consequence 18 young animals with small tusks were found dead either near the springs or in the mud.

In other areas the windmills have been, for the most part, well frequented by these animals.

Gemsbok.—This rare animal appears to be increasing in numbers and some fine herds have been seen.

Giraffe.—Giraffe have been seen in remarkable numbers, several visitors having recorded over 100 in a day. Lions have taken a fairly heavy toll, but most of the kills have been old animals.

Koodoo.—Koodoo were numerous along the roads and in the neighbourhood of the rest camp until October, when they migrated.

Roan and *Sable Antelope* are increasing satisfactorily and the water supplies at windmills have proved of great value to them.

Warthog.—Since the severe set-back which this animal received some years ago there has been a steady increase, although it is still by no means numerous. Several good litters were seen at the end of the year.

Wildebeeste.—Herds in the north are increasing rapidly, but the main population which inhabits the south-west corner of the Reserve had a very bad year and many died owing to the drying up of water supplies and the lack of grazing.

Zebra.—There has been a steady increase of these animals and there was a marked migration from the west in June, when they concentrated near the windmills.

Lions.—More lions have been seen than in any former year and, in fact, appeared to be too numerous in the neighbourhood of windmills. The Game Warden is of the opinion that it may be necessary to reduce the numbers if the same proportion is to be maintained, as they are at present making too heavy an inroad in the game population, which is still too low. He suggests a proportion of one lion to five or six hundred head of game, other than elephant.

Wild Dogs appear to have decreased in numbers and approximately twenty were destroyed by the staff.

Lake Alice.—During the year Lake Alice, well known as a breeding haunt of water birds was, with the co-operation of the Native Department, declared a sanctuary.

2. **Victoria Falls Game Reserve.**—The area was regularly patrolled by native rangers. Reedbuck and several herds of sable, eland and koodoo are now again well established in the reserve, from which they were driven some years ago by timber exploitation.

3. **Victoria Falls Reserve.**—The Curator reports that a recent census of the village shows that there is now a total of 65 Europeans, 8 Indians and 641 natives. The native village which is now in course of construction for the purpose of adequately housing local and immigrant labour will add considerably to the health of the Falls by removing many unsightly and unsanitary compounds.

A new camping site, 12 acres in extent, was cleared on high ground. When water and other facilities are provided camping may be undertaken with safety throughout the year.

Considerable improvements were effected during the year in clearing rank vegetation as an aid to malaria control and to improve vistas of the river and Falls. Paths were gravelled in the Rain Forest and new shelters and rustic seats were erected.

The Roads Department carried out an extensive programme on the main road to the North. The portion of the road from the village to the Bridge was tar surfaced with the exception of the last section, which is subject to frequent spray from the Falls. This section was reconstructed in concrete.

Twelve hundred persons used the camping sites during the year.

There were six prosecutions and convictions against cutting and damaging trees in the immediate vicinity of the Falls, and several warnings were administered in connection with carving on trees and other minor offences.

4. **Rhodes Inyanga Estate.**—With a view to controlling the agricultural and pastoral activities of the native tenants on the Estate a census and survey were undertaken towards the end of the year. It was found that there were 350 kraals on the Estate and 260 adult male natives as tenants, of whom, however, only one-fourth are permanently resident. Cattle, sheep and goats totalled 3,116 head, while the area under cultivation amounted to 1,465 acres. Plans are being prepared to control grazing and to overcome certain destructive methods of cultivation, particularly on hillsides.

Accommodation for Visitors.—The hotel and three rest camps were well patronised by visitors. A fourth rest camp is in course of construction and a fifth will be completed during 1939. Two guest houses maintained by private enterprise on the borders of the Estate afford additional facilities in the neighbourhood.

Tree Planting.—Sixteen plots, mainly of evergreen trees, and averaging about two acres in extent were planted for their scenic value and for experimental purposes. Overdue thinnings were carried out in two stands of *Pinus patula* and *Pinus radiata*.

Several fires in grassland areas occurred but no plantations, which were adequately protected, were damaged. Seven natives were convicted for firing indigenous forest in the Pungwe Gorge.

Roads.—Ten miles of road were constructed and now provide an additional loop to the Circular Drive and access to the Nyamziwa Falls and the lower reaches of the Nyamgombi River. All routes and places of interest were adequately signposted.

Fruit and Berry Experiments.—The Manager reports: "The following are being tried out: Pecans, tung, Macadamia nuts, chestnuts, persimmons, varieties of figs, olives, mulberries, currants, raspberries, blackberries, loganberries and strawberries.

"Of the trees it is too early for data of value, though the majority are making satisfactory growth, and the berry plots are small. The latter will be extended this year. Of the strawberries the Vumba shows the best combination of qualities. Best growth is shown by Fendelcino and Mission Marvel, though the fruit is inferior.

"In the matter of pasture experiments ten acres are being prepared on contour-ridged land for winter grasses under irrigation."

Game Birds.—Sixty eggs of English pheasant were imported from England by air mail and placed under domestic hens at the Salisbury Poultry Station. There were 32 hatchings, but 10 of the chicks succumbed. The remaining birds developed well and 15 were penned in a large enclosure on the Estate and at the end of the year they were thriving.

Further introductions of pheasant and also of Indian Chikor are contemplated for 1939.

Trout.—Portions of the Inyangombie River System are now fairly well stocked with rainbow trout and it will now be possible to stock other streams direct from the river. During September large numbers of fry were noted in the Mare River as the result of natural breeding.

An excellent consignment of 11,000 brown trout ova was received from the Perie Hatchery, Kingwilliamstown, on the 21st August, but one tray of 814 ova, spawned on the 10th and 11th July, were found already hatched and useless. The balance of the ova hatched uniformly well.

From this hatching 5,000 alevins were planted in September in the Pungwe River System. The plantings were spread over a distance of two to three miles in suitable places in the upper reaches of each of two main tributaries. The balance of the fry are being retained in feeding ponds for liberation in a third tributary towards the end of the rainy season.

The 1937-38 fishing season lasted from the 1st November, 1937, to the 28th February, 1938. At the beginning of the season the waters were very low, but prolonged rainy spells occurred during the latter half. Many anglers failed to submit records of their catches. From the cards returned 179 rainbow trout with an average weight of 1 lb. 10 ozs. were retained. The average condition factor of the fish taken was 50.

The present season opened on the 1st October and cards returned to the end of the year show that 316 fish of an average weight of 1 lb. 3 ozs. were taken.

As a result ot Mr. Sutton's report it is intended to undertake a survey of all potential trout waters during 1939 with a view to stocking under Government control.

X. GENERAL.

1. **Legislation.**—In order to conform with certain requirements of the International Convention for the Protection of the Flora and Fauna of Africa, several important amendments were introduced into the "Game and Fish Preservation Act, 1929."

2. **Rainfall.**—The rainfall for the calendar year recorded at the various field stations was as follows:—

Stapleford Forest Reserve (Three Stations).—74.96 ins.; 76.78 ins.; 75.20 ins.

Mtao Forest Reserve (Two Stations).—31.77 ins.; 30.06 ins.

Gwaai Forest Reserve.—25.58 ins.

Salisbury Forest Nursery.—37.78 ins.

Wankie Game Reserve.—14.85 ins.

3. **Livestock.**—Livestock on hand at the end of the year at all Stations totalled 7 horses, 175 oxen and 47 donkeys.

4. **Publications.**—The following Bulletins were published during the year:—

"Some Trees, Shrubs, Shrubby Herbaceous Plants, Climbers and Water Plants suitable for the Colony." J. W. Barnes, Manager, Forest Nursery.

"The Control of Veld Fires." Division of Forestry.

"Pruning of Plantations." R. H. Finlay, B.A. (Oxon.).

"18th Annual Report of the Division of Forestry, 1937."

"Report on Trout Streams." C. Sutton, Inland Fisheries Officer, Natal.

"The Pot Planting of Eucalypts." Major G. R. Wake.

"The Raising and Planting of Trees on the Farm." E. J. Kelly Edwards, M.A., Dip. For. (Oxon.).

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HUMUS—

1. ENLIVENS the soil.
2. MAKES a home for bacteria.
3. ADMITS air and water into the soil.
4. RETAINS the moisture.
5. KEEPS the soil loose and warm.
6. MAKES the soil more productive.
7. PREVENTS washing, packing and baking.

Departmental Bulletins.

Copies of these Bulletins may be obtained from the Editor, Box 387, Salisbury. They are issued free to residents of Southern Rhodesia and a charge of 3d. per copy is made in all other cases.

N.B.—The date the article appeared in the Journal is indicated in abbreviated form before the number, e.g., 8/22, No. 429, means that Bulletin 429 appeared in the Journal for August, 1922.

AGRICULTURE AND CROPS.

7/25. No. 545. Artificial or Synthetic Farmyard Manure, by H. G. Mundy, Dip.Agric., F.L.S.
5/27. No. 643. Noxious Weeds in Southern Rhodesia, by F. Eyles, Botanist.
12/27. No. 663. The Use of Fertilisers and Manures in Southern Rhodesia, by A. D. Husband, A.I.C., Chief Chemist.
2/28. No. 674. Top Dressing of Maize against Stalk Borer, by H. C. Arnold.
3/28. No. 681. The Sunflower (Helianthus Annuus) (Revised), by S. D. Timson, M.C., Dip.Agric.
6/28. No. 695. The Castor Oil Plant (Ricinus spp.), by S. D. Timson, M.C., Dip.Agric.
9/28. No. 705. Suggested Cropping Programmes for Farms on the Sand Veld, by D. E. McLoughlin, Assistant Agriculturist.
10/28. No. 710. Monthly Reminders for the Farming Year, by the Division of the Chief Agriculturist.
3/29. No. 727. Farmyard Manure, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.
3/29. No. 732. Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.
7/29. No. 743. Sunn Hemp, by S. D. Timson, M.C., Dip.Agric.
9/29. No. 751. The Sweet Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).
10/29. No. 758. Instructions for Taking Soil Samples. Issued by the Division of Chemistry.
1/30. No. 768. The Ground Nut (Arachis hypogaea), by S. D. Timson, M.C., Dip.Agric. (Wye).
3/30. No. 776. Regulations Governing the Export of Maize and Maize Meal through the Port of Beira.
11/30. No. 797. Green Manuring: An Essential Practice in Rhodesian Farming, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief Agriculturist.
1/31. No. 802. Witch Weed, by S. D. Timson, M.C., Inter.B.Sc. (Agric.) London., Dip.Agric (Wye), Assistant Agriculturist.
3/31. No. 815. New Strains of Oats for Southern Rhodesia, by H. C. Arnold, Manager,. Agricultural Experiment Station, Salisbury.

4/31.	No 816.	Preliminary List of the more Common Grasses of Southern Rhodesia, by Sydney M. Stent, Botanist for Pasture Research.
5/31.	No. 822.	Re-stacking of Maize rejected for Export on account of Excessive Moisture.
9/31.	No. 826.	Some Poisonous Plants of Southern Rhodesia, by Sydney M. Stent, Senior Botanist.
10/31.	No. 831.	Revised Notes on Cotton Growing in Southern Rhodesia, by G. S. Cameron.
11/31.	No. 836.	The Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).
12/31.	No. 837.	Veld Grass Silage: A Feature in Rhodesian Pasture Management, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief, Division of Plant Industry.
6/32.	No. 855.	Pigeon-hole Method of Stacking Maize, by Division of Plant Industry.
8/32.	No. 859.	Twenty-one Years of Plant Introduction, by Major Mundy, Chief Division of Plant Industry.
2/33.	No 878.	A.I.V. Silage: Memorandum prepared and circulated by Imperial Bureau of Animal Nutrition.
11/34.	No. 936.	Witchweed, by S. D. Timson, M.C. Dip.Agric. (Wye), Assistant Agriculturist.
10/35.	No. 970.	Rhodes Grass for the Southern Rhodesian Tobacco Grower, by African Explosives and Industries, Ltd.
11/35.	No. 972.	Notes on Witchweed, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.
6/36.	No. 992.	Annual Report of the Agriculturist for the year 1935, by D. E. McLoughlin, Agriculturist.
8/36.	No. 997.	Reward Wheat: Report on the Baking Properties and Chemical Analyses, by The Rhodesian Milling and Manufacturing Co., Ltd.
4/37.	No. 1022.	Smut Diseases of Wheat in Southern Rhodesia, by G. M. Wickens, B.Sc. Agric., Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.
9/37.	No. 1044.	Farming Calendar.
10/37.	No. 1046.	Green Manuring: Two Important Factors Affecting Success, by S. D. Timson, M.C., Assistant Agriculturist, and H. C. Arnold, Manager, The Agricultural Experiment Station.
10/38.	No. 1084.	Improved Pastures, by S. D. Timson, M.C., Assistant Agriculturist.
11/38.	No. 1089.	Witchweed and the Labour Shortage, by S. D. Timson, M.C., Assistant Agriculturist.
2/39.	No. 1101.	Grass Silage, by H. C. Arnold, Manager, Salisbury Experiment Station.
10/39.	No. 1129.	Pyrethrum, by H. C. Arnold, Manager, Agricultural Experiment Station, Salisbury.
11/39.	No. 1131.	Witchweed, by Division of Agriculture.
12/39.	No. 1136.	Compost, by S. D. Timson, M.C., Assistant Agriculturist

REPORTS ON CROP EXPERIMENTS.

7/27.	No. 649.	Annual Report of Experiments, 1925-26, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Manager.
4/28.	No. 683.	Annual Report of Experiments, 1926-27, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Station Manager.

7/29.	No. 745.	Salisbury Agricultural Experiment Station Annual Report, 1927-28, by H. C. Arnold.
7/30.	No. 789.	Agricultural Experiment Station, Salisbury. Annual Report of Experiments, 1928-29, by H. C. Arnold.
9/31.	No. 830.	Salisbury Agricultural Experiment Station, Annual Report, 1929-30, by H. C. Arnold, Manager.
10/32.	No. 864.	Annual Report, 1930-31: Agricultural Experiment Station, by H. C. Arnold, Station Manager.
6/33.	No. 895.	Salisbury Agricultural Experiment Station Annual Report, 1931-32, by H. C. Arnold, Manager.
3/34.	No. 914.	Gwelo Municipal Demonstration Station: Final Report, 1933, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.
9/35.	No 965.	Salisbury Agricultural Experiment Station Annual Report, 1933-34, by H. C. Arnold, Manager.
5/39.	No. 1110.	The Management and Utilisation of Natural Pastures, by H. C. Arnold, Manager, Salisbury Experiment Station.
6/39.	No. 1113.	Wheat Production in Southern Rhodesia, by D. E. McLoughlin, Agriculturist.

TOBACCO.

8/26.	No. 605.	Flue-curing Tobacco Barns, Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.
9/26.	No. 615.	The Culture of Virginia Tobacco in Southern Rhodesia: Field Management, by D. D. Brown.
5/27.	No. 641.	The Handling, Grading and Baling of Cured Virginia Tobacco, by D. D. Brown.
5/27.	No. 644.	Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.
9/27.	No. 653.	The Care of Tobacco Seed-Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)
11/27.	No 661.	Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16 ft., by B. G. Gundry.
1/28.	No. 665.	Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
2/28.	No. 671.	Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.
12/28.	No. 715.	Turkish Tobacco Culture in Southern Rhodesia, by D. D. Brown, Chief Tobacco Expert.
3/29.	No. 728.	Suggested Crop Rotations for Tobacco Growers, by D. D. Brown, Chief Tobacco Expert.
4/29.	No. 734.	Common Faults in Curing Virginia Bright Tobacco, by D. D. Brown, Tobacco and Cotton Expert.
8/29.	No. 748.	Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
9/29.	No. 753.	Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
2/30.	No. 771.	Dark Fire-cured Tobacco: Field Operations, by D. D. Brown, Chief Tobacco Expert.
3/30.	No. 774.	Dark Fire-cured Tobacco: Harvesting and Curing, by D. D. Brown, Chief Tobacco Expert.
6/30.	No. 784.	Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.
3/31.	No. 812.	Selection of Tobacco Seed Plants, by H. F. Ellis, M.Sc., B.S. (Agric.), Tobacco Adviser.

11/31.	No. 835.	Tobacco Culture: Transplanting Operations, by D. D. Brown.
3/32.	No. 846.	Leaf Curl in Tobacco, by Dr. H. H. Storey.
3/33.	No. 885.	Tobacco Culture in Southern Rhodesia: The Harvesting and Curing of Virginia Tobacco, by D. D. Brown, Chief Tobacco Officer.
8/36.	No. 996.	The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.
12/36.	No. 1009.	Tobacco Research on the Trelawney Station 1935-36 Season.
4/37.	No. 1025.	Report of the Tobacco Research Board, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture and Chairman of the Tobacco Research Board.
5/37.	No. 1026.	Notes on Tobacco Root-Knot Nematode, by J. C. Collins, B.Sc., Biologist, Trelawney Tobacco Research Station.
8/37.	No. 1039.	Some Tobacco Pests that can be serious, by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.
1/38.	No. 1054.	Alkalinity of Tobacco Seed-bed Soils, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.
3/38.	No. 1063.	A New and Serious Disease of Tobacco in Southern Rhodesia, by G. M. Wickens, Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.
6/38.	No. 1072.	Report of the Tobacco Research Board for the year ending 31st December, 1937, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture, and Chairman of the Tobacco Research Board.

LIVE STOCK.

1/27.	No 624.	The Construction of Dipping Tanks for Cattle (Revised).
1/31.	No. 801.	Sheep Farming in the Melsetter District, by J. C. Kruger, Part-time Sheep Adviser in the Melsetter District.
10/32.	No. 863.	Piggeries, by B. G. Gundry, A.I.Mech.E.
12/32.	No. 871.	Some General Observations on the Feeding of Dairy Cows on a Mixed Stock Farm, by Dr. A. E. Romyn, Senior Animal Husbandry Officer.
4/33.	No. 887.	The Type of Chiller Steer required for Export, by A. E. Romyn, Senior Animal Husbandry Officer.
9/33.	No. 903.	The Handling, Preparation and Chilling of Cattle for Export, by C. A. Murray, Lecturer in Animal Husbandry.
12/33.	No. 907.	The Blackhead Persian: Its Breeding and Management in Matabeleland, by C. A. Murray, M.Sc., Lecturer in in Animal Husbandry, Matopo Estate.
1/34.	No. 909.	Stall Fed Chillers for the Overseas Christmas Market, by C. A. Murray, M.Sc., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.
2/34.	No. 912.	Economical Winter Rations for Wintering Dairy Heifers, by C. A. Murray, M.Sc. (Agric), Lecturer in Animal Husbandry, Matopo School of Agriculture.
4/34.	No. 916.	Cowpea Hay in the Ration for Bacon Pigs, by C. A. Murray, M.Sc. (Agric.). Lecturer in Animal Husbandry, Matopo School of Agriculture and Experiment Station.
6/34.	No. 924.	Raising Dairy Calves on a Limited Amount of Whole Milk, by C. A. Murray, M.Sc., Agr., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

1/35.	No. 943.	Cattle Improvement and a Cattle Breeding Policy in Southern Rhodesia: A Review of the General Position Chiefly as regards Ranching Cattle, by Dr. A. E. Romyn, Chief Animal Husbandry Officer.
1/35.	No. 945.	A Home-made Cow Stanchion, by Major R. R. Sharp, Whinburn, Redbank.
3/35.	No. 946.	Economical Rations for Wintering Dairy Cattle, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station.
5/35.	No 952.	Annual Report of the Chief Animal Husbandry Officer for the year ending 31st December, 1934, by A. E. Romyn, Chief Animal Husbandry Officer.
7/35.	No. 959.	The Selection of a Dairy Bull, by A. E. Romyn, Ph.D., Chief Animal Husbandry Officer.
4/36.	No. 984.	Report on the Curing of Rhodesian Hides, by Advisory Committee on Hides and Skins of the Imperial Institute.
4/36.	No 985.	Export of Frozen Porkers. Third Consignment to Smithfield. Division of Animal Husbandry.
5/36.	No. 987.	The Curing of Hides and Skins on the Farm, by The Division of Animal Husbandry.
5/36.	No. 988.	Preparing Cattle for Show, by The Animal Husbandry Division.
6/36.	No. 989.	The Supplementary Feeding of Mineral and Protein Supplements to Growing Cattle in Southern Rhodesia and its Relation to the Production of Beef Steers, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Southern Rhodesia; D. G. Haylett, Ph.D., Director, Rhodes Matopo Estate; F. Ericksen, Dip. Agric., Experimentalist.
9/36.	No. 1000.	Sheep Management on the Mixed Farm, by R. H. Fitt, Animal Husbandry Officer.
10/36.	No. 1001.	The Raising of Bacon Pigs, by A. E. Romyn, Chief Animal Husbandry Officer, and C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate, with a Veterinary Section by D. A. Lawrence, Director of Veterinary Research.
4/37.	No. 1023.	Cowpea Molasses Silage for Fattening Steers, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Salisbury; R. H. Fitt, Dipl. Agric., Animal Husbandry Officer, Department of Agriculture, Salisbury.
4/37.	N. 1024.	Comparative Feeding Value of Maize Meal and Nyouti (*Pennisetum Typhoides*) Meal for Fattening Steers, by C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Chief Animal Husbandry Officer.
5/37.	No. 1027.	The Feeding of Phosphorus Supplements to Growing Cattle by C. A Murray and A E Romyn.
5/37.	No. 1029.	The Dehorning of Cattle intended for Slaughter and Export, by B. A. Myhill, Assistant Chief Veterinary Surgeon.
5/37.	No. 1030.	The Feeding of Different Winter Supplements to young growing steers and the effect of these supplements on the subsequent development and costs of production of the steers, by C. A. Murray and A. E. Romyn.

6/37.	No. 1032.	The Effects of Feed on the Firmness and Grading of Bacon Carcases, an experiment carried out by the Division of Animal Husbandry in co-operation with Mr. A. L. Millar, Estes Park, Salisbury, and Mr. Frank Neill, of Neill's Bacon Factory, Salisbury.
6/37.	No. 1034.	Nyouti or Munga (*Pennisetum typhoides*) as a Feed for Bacon Pigs, by C. A. Murray and A. E. Romyn.
7/37.	No. 1036.	Preliminary Report on the Feeding of Winter Supplements to young growing steers and the effect of supplementary feeding on the subsequent development of these animals, by C. A. Murray and A. E. Romyn.
12/37.	No. 1049.	The Export of Frozen Porkers: Report on Five Consignments of Porkers Exported to Smithfield, by Division of Animal Husbandry.
1/38.	No. 1053.	The Feeding of Sunnhemp Hay as compared with Cowpea Hay in the Fattening Ration for Bullocks, by A. E. Romyn and R. H. Fitt
2/38.	No. 1058.	Pig Industry Act, 1937. Division of Animal Husbandry.
9/38.	No. 1083.	Internal Parasites in Sheep, by Percy D. Huston, M.R.C.V.S., District Veterinary Officer.
11/38.	No. 1091.	Cost of Fattening Bullocks of various ages in Matabeleland, by A. E. Romyn and C. A. Murray.
7/39.	No. 1120.	Urea as a possible substitute for Peanut Cake for Wintering Young Stock, by C. A. Murray and A. E. Romyn.
6/39	No. 1115.	Feeding Young Stock in Winter, by C. A. Murray, M.Sc. (Agr.) and A. E. Romyn, Ph.D., Division of Animal Husbandry, Department of Agriculture, Southern Rhodesia.

DAIRYING.

12/30.	No. 799.	The Objects of Ripening Cream for Butter-making, and a few Hints on Cream Production, by F. Lammas, Dairy Officer.
9/32.	No. 862.	Cream Cheese, by F. A. Lammas, Dairy Officer.
3/33.	No. 880.	Dairy Tests and Calculations, by F. A. Lammas, Dairy Officer.
5/34.	No. 922.	Dairy Building in Southern Rhodesia: A Small Farm Dairy, by G. B. Gundry, A.I.Mech.E.
7/34.	No. 926.	Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.
12/34.	No 937.	Gouda or Sweet Milk Cheese, by F. Lammas, District Dairy Officer.
2/36.	No. 977.	Notes on the Feeding of Dairy Cows during the Summer Months, by A. E. Romyn, Chief Animal Husbandry Officer.
6/36.	No. 990.	Southern Rhodesia Milk Recording Scheme.
12/37.	No. 1051.	The Production and Handling of Milk and Cream, by the Dairy Branch.
12/38.	No. 1094.	Farm Butter Making, by The Dairy Branch.

VETERINARY.

10/14.	No. 191.	Scab or Scabies in Sheep and Goats, by Rowland Williams, M.R.C.V.S.
12/25.	No. 570.	The Spaying of Bovines, by G. C. Hooper Sharpe, M.C., M.R.C.V.S., and M. H. Kingcombe, M.R.C.V.S.

6/26. No. 597. Suspected Poisoning of Stock: The Proper Procedure, by M. H. Kingcombe, M.R.C.V.S. (Lond.), and A. W. Facer, B.A. (Oxon.), A.I.C.

12/26. No. 618. Notes from the Veterinary Laboratory: Quarter Evil, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

1/28. No. 666. Notes from the Veterinary Laboratory: Praemonitus—Praemunitus, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

10/29. No. 756. Parasitic Gastritis of Cattle, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

11/29. No. 760. A Note on Sheep Diseases in Southern Rhodesia, by D. A. Lawrence, B.V.Sc., Veterinary Research Officer, Department of Agriculture, Salisbury.

2/30. No 772. Notes from the Veterinary Laboratory: Ophthalmia, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

4/31. No. 819. Measles in Swine, by P. D. Huston, M.R.C.V.S.

1/32. No. 841. Poisonous or Suspected Poisonous Plants of Southern Rhodesia: Tulip Poisoning of Cattle, by Sydney M. Stent, Senior Botanist, and D. A. Lawrence, B.V.Sc., Veterinary Research Officer.

10/32. No. 866. The Treatment of Intestinal Parasites of Sheep, by J. D. Coutts, D.V.S., M.R.C.V.S.

4/33. No. 886. A Preliminary Note on Contagious Granular Vaginitis in Southern Rhodesia, by D. A. Lawrence, B.V.Sc., Acting Director Veterinary Research.

IRRIGATION, WATER SUPPLIES AND SOIL EROSION.

4/27. No. 640. Levelling for Irrigation, by Dr. W. S. H. Cleghorn, M.I.Mech.E.

11/27. No. 659. The Hydraulic Ram, revised by P. H. Haviland, B.Sc.

11/28. No. 668. The Water Act, 1927, by C. L. Robertson, B.Sc. (Eng.), A.M.I.C.E.

1/28. No 670. Irrigation Canals, by P. H. Haviland, B.Sc. (Eng.).

6/30. No. 786. Low Concrete Dams, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

2/31. No. 808. The Application of Water in Irrigation, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

3/31. No 811. Irrigation Canal Structures, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

8/32. No. 860. Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

2/33. No 879. Conditions Governing the Hire of Government Boring Machines.

6/35. No 956. Annual Report of the Division of Irrigation for the year ended 31st December, 1934, by P. H. Haviland, B.Sc. (Eng.), Acting Chief Irrigation Engineer.

9/35. No. 964. The Use of Ditchers for Constructing Contour Ridges, by C. Tapson, Devondale, Concession.

9/35. No. 967. How to use an Engineer's or Farm Level, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E., Irrigation Engineer (Matabeleland).

12/35. No 973. Domestic Water Supplies and Sanitation on the Farm, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E.. Irrigation Engineer (Matabeleland).

3/36.	No. 980	Results from Glenara Soil Conservation Experiment Station, 1934-35 Season, by C. L. Robertson, B.Sc. A.M.I.C.E., Chief Engineer, Irrigation Division, and A. D. Husband, F.I.C., Chief Chemist.
8/36.	No. 999.	Lining an Irrigation Furrow, by R. H. Roberts, B.S., A.M.Inst.C.E., Assistant Irrigation Engineer.
1/38.	No. 1052	Small Earthen Storage Dams. Part I. By the Irrigation Division.
2/38.	No. 1055.	Small Earthen Storage Dams. Part II. By the Irrigation Division.
3/38.	No. 1061.	Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.
7/38.	No. 1077.	A Small Brick Irrigation Furrow, by H. W. H. Wallis, Assistant Irrigation Engineer.
1/39.	No. 1095.	Soil and Water Conservation, by D. Aylen, for the Irrigation Division.
9/39.	No. 1127.	Soil and Water Conservation. Part III. By D. Aylen and the Irrigation Officers.

FORESTRY.

11/29.	No 763.	The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B.Sc.F.
1/30.	No. 769.	The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B.Sc.F.
4/30.	No. 778	The Utilisation of Wood in Southern Rhodesia—Conversion and Disposal of Timber, by T. L. Wilkinson, M.Sc., B.Sc.F., District Forest Officer.
8/30.	No. 791.	The Utilisation of Wood in Southern Rhodesia: Fencing, by T. L. Wilkinson, M.Sc., B.Sc.F., District Forest Officer.
2/31.	No. 809.	Establishing Pines: Preliminary Observations on the Effects of Soil Inoculation. Issued by the Division of Forestry.
7/32.	No. 857.	Charcoal Burning on the Farm, by R. J. Allen, Forester, Rhodes Matopo School of Agriculture and Experiment Station.
11/32.	No 869.	Wind-breaks and Shelter Belts, by A. A. Pardy, B.Sc., Forestry.
1/33.	No. 874.	Tree Planting, by the Division of Forestry.
4/33.	No. 888.	The Vegetable Ivory Palm (Hyphoene ventricosa), by G. M. McGregor, B.Sc., District Forest Officer, Matabeleland.
8/34.	No. 927.	Some Facts about Tung Oil, by R. H. Finlay, B.A., Dip. For. (Oxon.), District Forest Officer.
8/34.	No. 928.	Some Trees, Shrubs, Shrubby-Herbaceous Plants, Climbers and Water Plants suitable for the Colony, by J. W. Barnes, Manager, Government Forest Nursery, Salisbury.
12/35.	No. 974.	Summary of the Annual Report of the Division of Forestry for the year 1934, by E. J. Kelly-Edwards, M.A., Dip. For. (Oxon.), Chief Forest Officer.
		Price List of Forest-tree Transplants, Ornamental Trees Shrubs, Hedge Plants, Creepers and Seeds obtainable at the Government Forest Nursery, Salisbury.
3/37.	No. 1020.	The Raising of Forest Seedlings and Transplants on the Farm, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.

10/37.	No. 1045.	Seventeenth Annual Report of the Division of Forestry for the Year 1936, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.
6/38.	No. 1073.	Pruning of Plantations, by R. H. Finlay, B.A., Oxon., Division of Forestry.
7/38.	No. 1076.	Eighteenth Annual Report of the Division of Forestry for the year 1937, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.
10/38.	No. 1085.	The Pot Planting of Eucalypts, by Major G. R. Wake, Vigila, Umvukwes.
11/38	No. 1087.	The Raising and Planting of Trees on the Farm, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon), Conservator of Forests.

HORTICULTURE

4/27.	No 637.	Harvesting, Packing and Marketing of Deciduous and Tropical Fruits, by G. W. Marshall, Horticulturist.
8/27.	No. 650.	Coffee Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.
2/29	No 725.	Investigations into "Collar-Rot" Disease of Citrus, by J. C. F. Hopkins, B.Sc. (Lond.), A.I C.T.A. (Trinidad)
11/31.	No. 834.	Celery Culture, by G. W. Marshall, Horticulturist.
2/33.	No. 876.	Notes on African Aloes (Parts 1-6), by H. Basil Christian, "Ewanrigg," Arcturus.
10/33.	No. 905.	Notes on African Aloes (Parts 7-10), by H. Basil Christian, "Ewanrigg," Arcturus.
5/34.	No. 920.	Citrus Fruit Growing in Rhodesia, by G. W. Marshall, Horticulturist.
5/37.	No. 1028.	Tomato Culture in Southern Rhodesia, by G. W Marshall, Horticulturist.
2/39.	No. 1100.	The Rhodesian Home Orchard, by G. W. Marshall, Horticulturist.

ENTOMOLOGY AND PLANT PATHOLOGY.

2/13.	No. 139.	Termites, or "White Ants," by Rupert W. Jack, F.E.S
6/15.	No. 214.	Some Household Insects, by R. Lowe Thompson, B.A
2/21.	No 385.	The Common Fruit Beetle, by R. W. Jack, F.E.S.
12/24	No. 522	Notes on the Black Citrus Aphis, by C. B. Symes.
8/25.	No. 548.	Insect Pests of Cotton, by C. B. Symes.
9/27.	No. 653.	The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad).
1/28	No. 665.	Tobacco Pests of Rhodesia, by Rupert W. Jack, F E.S., Chief Entomologist.
2/28.	No. 671.	Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.
6/28.	No. 696.	Ticks Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
11/28.	No. 714.	Trap Cropping against Maize Pests, by Rupert W. Jack, F.E.S., Chief Entomologist.
12/28.	No. 718.	Preliminary Experiments on the Control of White Mould of Tobacco, by J. C. F. Hopkins, B.S. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
3/29.	No. 732.	Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.
6/29	No. 742.	What is Diplodia in Maize? An Answer to a Popular Question To-day, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

8/29.	No. 748.	Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
9/29.	No. 753.	Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
9/29.	No. 754.	"Pinking" of Maize: Report of a Preliminary Investigation, by T. K. Sansom, B.Sc., Plant Breeder.
6/30.	No. 784.	Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.
6/30.	No. 788.	A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T A., Plant Pathologist.
		A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist. Supplement No. 1.
7/30.	No. 790.	Notes on the Control of Some of the More Important Insect Pests of Citrus in Southern Rhodesia, by W. J. Hall, Ph.D., B.Sc., Entomologist to the British South Africa Company in Southern Rhodesia.
10/30.	No. 796.	The Army Worm (Laphygma exempta, Wlk.), by Rupert W. Jack, Chief Entomologist.
11/30.	No. 798.	The Preparation of Bordeaux Mixture and Seasonal Notes on Tobacco Diseases, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.
1/31.	No. 804.	Locusts in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.
8/31.	No. 825.	Some Common Diseases of Potatoes in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.
3/32.	No. 848.	Mycological Notes: Seasonal Notes on Tobacco Diseases: 3, Frog Eye; 4, White Mould; by J. C. F. Hopkins, B.Sc. (Lond.).
4/32.	No. 850.	Pests of Stored Tobacco in Southern Rhodesia, by M. C. Mossop, M.Sc., Entomologist.
6/32.	No. 856.	A List of Plant Diseases occurring in Southern Rhodesia, Supplement 2, by J. C. F. Hopkins, B.Sc. (Lond.), Government Plant Pathologist.
9/32.	No. 861.	Further Notes on Leaf Curl of Tobacco in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.
5/33.	No. 892.	The Tsetse Fly Problem in Southern Rhodesia, by R. W. Jack, Chief Entomologist.
5/33.	No. 893.	Experiments with Tsetse Fly Traps against Glossina Morsitans in Southern Rhodesia, by R. W. Jack, Chief Entomologist.
6/33.	No. 894.	Mycological Notes. Seasonal Notes on Tobacco Diseases. 6. An Unusual Type of Frog Eye Spotting, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.
6/33.	No. 896.	A List of Plant Diseases occuring in Southern Rhodesia. Supplement 3. (New Records for period June, 1932, to May, 1933.) Compiled by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.
7/33.	No. 897.	The Report of the Chief Entomologist for the year ending 31st December, 1932, by Rupert W. Jack, F.E.S., Chief Entomologist.
8/33.	No. 899.	The Black Maize Beetle (Heteronchus Licus Klug), by C. B. Symes.

2/34.	No. 911.	Screw Worm. A Pest of Ranch Cattle in Southern Rhodesia, by A. Cuthbertson, Entomologist. Foreword by R. W. Jack, Chief Entomologist.
3/34.	No. 913.	Locusts: Instructions for dealing with Flying Swarms, by The Division of Entomology.
4/34.	No. 917.	The Life History of the Screw-worm Fly, by Alexander Cuthbertson, Entomologist.
10/34.	No 934.	Mycological Notes. Seasonal Notes on Tobacco Diseases. 7, Spraying in Seed-beds and Lands, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
12/34.	No. 938.	The Destruction and Control of Locust Hoppers, by R. W. Jack, Chief Entomologist.
1/35.	No. 942.	Mycological Notes. Seasonal Notes on Tobacco Diseases. 8, The Mosaic Mystery. 9, Danger Points in Field Spraying, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
4/35.	No. 950.	The Control of Tsetse Fly in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.
4/35.	No 951.	Suspected "Streak" Disease of Maize. Notice to Growers, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
6/35.	No. 957.	Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1934, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
8/35.	No. 962.	The Report of the Chief Entomologist for Year ending 31st December, 1934, by R. W. Jack, Chief Entomologist.
10/35.	No 969	The Objects and Value of Seed Treatment of Maize against Diplodia, by G. M. Wickens, Ph.D. (Lond.), D.I.C., Assistant Plant Pathologist.
5/36.	No 986.	Annual Report of the Division of Entomology for year ending 31st December, 1135, by Rupert W. Jack, Chief Entomologist.
7/36.	No. 993.	Annual Report of the Senior Plant Pathologist for year ending 31st December, 1935. Part I.: Plant Pathology. Part II.: Tobacco Research, by J. C. S. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist and Officer in Charge of Tobacco Research Station, Trelawney.
12/36.	No. 1011.	Tick Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist. Revised, November. 1936.
7/37.	No. 1037.	Division of Entomology: Annual Report for year 1936, by R. W. Jack, Chief Entomologist.
8/37.	No. 1040.	A Programme for the Control of Diseases of Apple Trees in Southern Rhodesia, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
10/37.	No. 1047.	Mycological Notes: Seasonal Notes on Tobacco Diseases. X.: Precautionary Methods in Seed-beds, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
12/37.	No. 1050.	An Unusual Winter Outbreak of Maize Weevil *Calandra oryzae*, L.), by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.
2/38.	No. 1059.	A Poison Bait for Young Locust Hoppers.
6/38.	No. 1071.	Common Diseases of Apples and their Control in Southern Rhodesia, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., and Aline L. Bacon, B.Sc., Division of Plant Pathology.

6/38.	No. 1074.	A Note on a Stem Rot of Sweet Peas, by J. C. F. Hopkins, D.Sc., A.I.C.T.A., Senior Plant Pathologist.
7/38.	No. 1078.	Mycological Notes: Seasonal Notes on Tobacco Diseases. 11. Two Destructive Curing Moulds, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
8/38.	No. 1079.	Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1937, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
8/38.	No. 1080.	Annual Report of the Division of Entomology for the year ended 31st December, 1937, by Rupert W. Jack, Chief Entomologist.
9/38.	No. 1082.	The Life History of Root Gallworm or Root Knot Eelworm, by M. C. Mossop, M.Sc., Entomologist.
10/38.	No 1086.	The Spraying of Tobacco Seed-beds and Control of Rosette Disease, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist, and M. C. Mossop, M.Sc., Entomologist.
1/39.	No. 1097.	Cleanliness Aids Insect Control: Some Examples of Agricultural Hygiene, by M. C. Mossop, M.Sc., Entomologist.
4/39.	No. 1108.	Three Important Strawberry Diseases, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
8/39.	No. 1121.	Report of the Division of Entomology for the year ending 31st December, 1938, by J. K. Chorley, Acting Chief Entomologist.
8/39.	No. 1122.	Report of the Branch of Plant Pathology for the year ending 31st December, 1938, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
10/39.	No. 1128.	Mycological Notes. 12. The Diplodia Danger, by J. C. F. Hopkins, D.Sc., A.I.C.T.A., Senior Plant Pathologist.
11/39.	No. 1132.	Mycological Notes. 13. The Diplodia Danger, by J. C. F. Hopkins. D.Sc., A.I.C.T.A., Senior Plant Pathologist.
12/39.	No. 1134.	Mycological Notes. 14. Seasonal Notes on Plant Diseases, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

POULTRY.

1/29.	No. 721.	Poultry Keeping in Rhodesia: Pedigree Breeding, by H. G. Wheeldon, Assistant Poultry Expert.
4/29.	No. 738.	Hints to Breeders: Rearing Young Stock, by A. Little, Poultry Expert.
6/29.	No. 740.	Artificial Incubation, Breeding and Rearing of Chicks, by H. G. Wheeldon, Poultry Expert.
11/29.	No 761.	Housing and Feeding of Adult Stock, by H. G. Wheeldon, Poultry Expert.
10/30.	No. 795.	The Turkey, by G. H. Cooper, Assistant Poultry Officer
1/31.	No. 803.	Geese, by G. H. Cooper, Assistant Poultry Officer.
9/31.	No. 827.	The Ideal Brooder, by F. Roberts, Assistant Poultry Officer.
10/32.	No. 865.	Poultry Industry: Care of Young Stock in Hot Weather, by H. G. Wheeldon, Chief Poultry Officer.
11/32.	No. 870.	Trap Nests, by B. G. Gundry, A.I.MechE. (combined with No. 875).

12/32	No 872.	The Rearing and Fattening of Table Poultry, by H. G. Wheeldon, Chief Poultry Officer.
3/33.	No 884.	The Vitamins in Poultry Feeding, by G. H. Cooper, Poultry Officer, Matopo School of Agriculture and Experiment Station.
5/34.	No 918.	The Moulting of Poultry: The Normal and Pullet Moult, by H. G. Wheeldon, Poultry Officer.
12/34.	No 940.	A Cheap Portable Colony House for Poultry, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station
3/34.	No. 947.	Modern Culling of Laying Hens, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.
9/35	No 966	Egg Marketing Bill: Draft of a Bill having for its purpose the more orderly Marketing of Eggs.
12/39.	No 1135.	Feeds for Poultry and How to Use Them, by G. H. Cooper, Assistant Poultry Officer.

The following pamphlets can be obtained from the Poultry Officer upon application:—

Selecting Birds for Laying Tests, by A. Little, Poultry Expert.
Tuberculosis, by A. Little, Poultry Expert.
Prevention of Disease among Poultry, by A. Little, Poultry Expert
Preparing Birds for Show, by A. Little, Poultry Expert.
The Fowl Tick (Argas persicus), by A. Little, Poultry Expert.
Culling: A Seasonal Operation, by A. Little, Poultry Expert.
Choosing a Male Bird, by A. Little, Poultry Expert.
The Breeding Stock, by A Little, Poultry Expert.
Diseases of the Digestive System, by A. Little, Poultry Expert
Mating for Improvement and Increased Egg Production, by A Little, Poultry Expert.
Partial Moult: Broodiness. Selection of Layers of Large Eggs, by A. Little, Poultry Expert
Exhibiting Eggs at Shows, by A Little, Poultry Expert
Condition of Birds on Show, by A. Little, Poultry Expert.
Green Food: The Result of not Supplying Sufficient to Poultry, by A. Little, Poultry Expert.
Good and Bad Hatching Eggs, by A Little, Poultry Expert.
Grading Fowls, by A. Little, Poultry Expert
Housing: Three Important Essentials, by A. Little, Poultry Expert.
Advice to Prospective Poultry Farmers, by A. Little, Poultry Expert
Seasonal Hints—August, by A. Little, Poultry Expert.
Successful Chick Rearing, by H G Wheeldon, Assistant Poultry Expert.
Hints to Breeders. October, by A. Little, Poultry Expert.
Abnormalities in Eggs, by A. Little, Poultry Expert.
Hints to Breeders. Prepare for the Breeding Season, by A. Little
Respiratory Diseases, by A. Little, Poultry Expert.
Selection and Preparation of Fowls for Exhibition, by H. G. Wheeldon, Poultry Expert.

The Close of the Hatching Season and After, by H. G. Wheeldon, Poultry Expert

7/38.	No 1075.	The Artificial Incubation, Brooding and Rearing of Chickens, by H. G. Wheeldon, Poultry Officer.
11/38	No. 1090	A Cheap Portable Colony House for Poultry, by G. H. Cooper, Assistant Poultry Officer.
12/38.	No 1092	Feeding and Drinking Appliances for Poultry, by G. H. Cooper, Assistant Poultry Officer
5/39.	No. 1111.	Ducks on the Farm, by H. G. Wheeldon, Poultry Officer.

METEOROLOGICAL.

12/22.	No. 436.	The Possibility of Seasonal Forecasting and Prospects for Rainfall Season, 1922-23, by C. L. Robertson, B.Sc., A.M.I.C.E.
12/24.	No. 524.	The Use of an Aneroid Barometer, by C. L. Robertson, B.Sc., A.M.I.C.E.
2/25.	No. 532.	The Short Period Forecast and Daily Weather Report, by C. L. Robertson, B.Sc., A.M.I.C.E.
6/25.	No 542.	Review of the Abnormal Rainfall Season, 1924-25, by C. L. Robertson, B.Sc., A.M.I.C.E.
10/28.	No. 712.	The Time, and How to Find It, by N. P. Sellick, M.C., B.Sc. (Eng.).
10/31.	No. 832.	The Weather Map and the Short Period Weather Forecast, issued by the Meteorological Office.
2/33.	No. 877.	Clouds and Weather in Southern Rhodesia, by N. P. Sellick, M.C., B.Sc., Meteorologist.
3/35.	No. 948.	The Weather, contributed by The Meteorological Office.

AGRICULTURAL BUILDINGS.

4/26.	No. 588.	Concrete on the Farm, by N. P. Sellick, M.C., B.Sc. (Eng.), Assistant Irrigation Engineer.
8/26.	No. 605.	Flue-curing Tobacco Barns. Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.
5/27.	No. 644.	Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.
11/27.	No. 661.	Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16ft., by B. G. Gundry.
10/32.	No. 863.	Piggeries, by B. G. Gundry, A.I.Mech.E.
5/33.	No 889.	The Construction of Dipping Tanks, by B. G. Gundry, A.I.Mech.E.; and Notes on their Management, by J. M. Sinclair, M.R.C.V.S., Chief Veterinary Surgeon.
9/33.	No. 902.	Brick-making on the Farm, by A. C. Jennings, Assoc.M.Inst.C.E.
12/33.	No. 908.	A Charcoal Safe or Cooler, by B. G. Gundry, A.I.Mech.E., Irrigation Division.
5/34.	No. 922.	Dairy Building in Southern Rhodesia: A Small Farm Dairy, by B. G. Gundry, A.I.Mech.E.
7/34.	No 926.	Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.
10/36.	No. 1002.	A Simple Farm Gate, contributed by the Division of Forestry.
5/37.	No. 1031.	Cattle Bale Grip.
8/37.	No. 1041.	Feeding Pens for Bullocks: the Layout at Estes Park. near Salisbury.
1/39.	No. 1098.	The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.

CHEMISTRY.

12/29.	No. 762.	—The Value of Rock Phosphate and "Bone and Superphosphate" as Fertilisers for Maize Production, by A. D. Husband, Chief Chemist.
4/32.	No. 852.	Mixing of Fertilisers: A Guide to Methods of Calculation, by the Division of Chemistry.
7/32.	No. 858.	The Softening of Waters, by the Division of Chemistry.

1/34.	No. 910.	The Toxicity to Grazing of Grass Sprayed with a Solution of Sodium Arsenite, by A. D. Husband, F.I.C., and J. F. Duguid, M.A., B.Sc.
9/34.	No. 930.	Analyses of Rhodesian Foodstuffs, by The Division of Chemistry.
		Chemist.
5/35.	No. 954.	Experiments on the Toxicity to Fowls of Arsenite of Soda and Poisoned Locusts, by J. K. Chorley, F.R.E S., and R. McChlery, B.A., B.Sc.
4/36.	No. 983.	Annual Report of the Branch of Chemistry for year ending 31st December, 1935, by A. D. Husband, F.I.C., Chief Chemist.
7/37.	No. 1035.	Analyses of Rhodesian Foodstuffs, by The Division of Chemistry.

MISCELLANEOUS.

4/28.	No. 686.	The Land Bank, Its Functions and How it Operates, by S. Thornton.
4/28.	No. 687.	The Use of Explosives on the Farm, by P. H. Haviland, B.Sc. (Eng.).
9/28.	No. 707.	Wood-Charcoal in Southern Rhodesia, by T. L. Wilkinson, B.Sc., Assistant Forest Officer.
5/31.	No. 820.	The Great Economic Problem in Agriculture—No. 1, by J. R McLoughlin, M.Sc. (Economist), Economic Adviser.
6/31.	No 823.	The Law of Supply and Demand—No. 2, by J. R. McLoughlin, M.Sc. (Economics), Economic Adviser.
		Twelve Simple Rules for the Avoidance of Malaria and Blackwater.
		Summary of the Game Laws of Southern Rhodesia.
11/34.	No. 935.	The Weeds and Poisonous Plants of Southern Rhodesia, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture. Part I.
8/35.	No. 961.	A Home-made Ridger. Contributed by Mr. Douglas Aylen, Somerset, Concession.
1/36.	No. 975.	Fertilizers, Farm Foods, Seeds and Pests Remedies Ordinance, 1914.
2/36.	No. 979.	The Prospects of Black Bass in the Inland Waters of Southern Rhodesia. Specially contributed
6/36.	No. 991.	Silage and Silos.
8/36.	No. 998.	Summary of the Game Laws of Southern Rhodesia.
3/37.	No. 1018.	Veld Fires. The "Forest and Herbage Preservation Act, 1936," by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Chief Forest Officer.
3/37.	No. 1021.	Breaking in Young Oxen to the Yoke, by J. B. West, Dromoland, P.B. Lonely Mine.
7/37.	No. 1038.	Star Bur-weed (*Acanthospermum australe*, O. Kuntze), by Chas. K. Brain, D.Sc., Director of Agriculture.
8/37.	No. 1042.	Weeds of Southern Rhodesia. Part II. By Chas. K. Brain, D.Sc., Director of Agriculture.
2/38.	No. 1056.	Notes on the Cashew Nut. By C. K. Brain, Director of Agriculture.
2/38.	No. 1057.	The Preservation of Farm Beacons and how to make use of the Fencing Law.
2/38.	No. 1060.	How to make Tobacco-Wash on the Farm, by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.
3/38.	No. 1064.	Farm Roads, by Stuart Chandler, Chief Road Engineer.

4/38.	No. 1065.	Nitrification in Red Soil in the Salisbury Area, by A. P. Taylor, M.A., B.Sc., and B. S. Ellis, B.Sc., A.I.C., D.I.C., Agricultural Chemists.
4/38.	No. 1067.	Grass Mowers, by H. Beynon, from "The Farmer," March 4th, 1938.
4/38.	No. 1068.	The Control of Veld Fires, by The Division of Forestry.
9/38.	No. 1081.	Uncontrolled Grass and Forest Fires and their Prevention, by the Rev. Father A. B. Burbridge, S.J.
11/38.	No. 1088.	How to Instal a Simple and Efficient Hot Water Supply on a Farm, by W. A. Welch, Tantallon Farm, Salisbury.
1/39.	No. 1096.	Trees and Wild Flowers on the Rhodesian Farm. Part I. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.
2/39.	No. 1099.	Trees and Wild Flowers on the Rhodesian Farm. Part II. By Chas. K. Brain, M.A., D.Sc , Director of Agriculture.
3/39.	No. 1102.	Trees and Wild Flowers on the Rhodesian Farm. Part III. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.
4/39.	No. 1106.	Trees and Wild Flowers on the Rhodesian Farm. Part IV. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.
5/39.	No. 1109.	Summary of the Game Laws of Southern Rhodesia, as at 1st May, 1939.
5/39.	No. 1112.	Trees and Wild Flowers on the Rhodesian Farm. Part V. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.
6/39.	No. 1116.	Trees and Wild Flowers on the Rhodesian Farm. Part VI. By Chas K. Brain, M.A., D.Sc., Director of Agriculture.
7/39.	No. 1119.	Trees and Wild Flowers on the Rhodesian Farm. Part VII., by Chas. K. Brain, M.A , D.Sc., Director of Agriculture.
4/39.	No. 1103.	Scurvy and How to Prevent It. Public Health Pamphlet No. 3.
4/39.	No. 1105.	Fumigation with Hydrocyanic Acid Gas, by M. C. Mossop, M.Sc.
4/39.	No. 1107.	Some Notes on Game Bird Preservation, by W. E. Poles, Esq., on behalf of the Wild Life Protection Society of Southern Rhodesia.
6/39.	No. 1114.	The Rhodes Inyanga Estate.
7/39.	No. 1118.	Grass Fires and Fire-belt Burning, by J. R. Perrins, P.B.S. Ranch, Fort Rixon.
8/39.	No. 1123.	Trees and Wild Flowers on the Rhodesian Farm. Part VIII. By Chas K. Brain, M.A., D.Sc., Director of Agriculture.
8/39.	No. 1124.	Cattle Bale or Grip.
9/39.	No. 1125.	Trees and Wild Flowers on the Rhodesian Farm. Part IX. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.
9/39.	No. 1126.	The Course of Prices of Certain Agricultural Products in Salisbury, by the Acting Government Statistician.
11/39.	No. 1130.	The Conditions Governing the Hire of Government Boring Machines, by Major C. E. Goad, M.C., Boring Superintendent.
12/39.	No. 1133.	Trees and Wild Flowers on the Rhodesian Farm. Part X. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

Rhodesia Weather Bureau.

OCTOBER.

PRECIPITATION.

Station	Inches.	Normal.	No. of days.
Beitbridge	0.30	0.85	2
Bindura	1.90	0.59	5
Bulawayo	1.22	0.74	7
Chipinga	0.75	1.51	5
Enkeldoorn	1.35	1.05	4
Fort Victoria	0.42	0.90	5
Gwaai Siding	0.61	0.41	7
Gwanda	0.71	0.79	3
Gwelo	2.56	0.67	8
Hartley	1.85	1.03	4
Inyanga	2.20	1.12	4
Marandellas	2.00	1.28	5
Miami	0.47	0.37	5
Mount Darwin	1.22	0.39	6
Mount Nuza	3.17	1.11	11
Mtoko	3.22	0.62	6
New Year's Gift	0.03	0.92	2
Nuanetsi	0.31	0.93	2
Plumtree	0.12	0.74	2
Que Que	0.91	0.73	4
Rusape	2.08	0.76	6
Salisbury	2.08	1.10	5
Shabani	0.30	0.67	3
Sinoia	1.38	0.83	6
Sipolilo	0.19	0.48	2

Station.	Inches.	Normal.	No. of days.
Stapleford	3.04	1.78	10
Umtali	1.10	1.08	7
Victoria Falls	1.92	0.53	9
Wankie	0.98	0.36	3
Abercorn	0.21	—	2
Balovale	4.30	—	7
Broken Hill	1.71	—	4
Chinsali	1.09	—	1
Choma	0.64	—	2
Fort Jameson	1.65	—	2
Fort Roseberry	0.88	—	2
Isoka	0.10	—	1
Kalomo	2.26	—	5
Kanchindu	0.40	—	3
Kasama	1.28	—	5
Kasempa	1.91	—	8
Luangwa	0.79	—	3
Livingstone	1.93	—	8
Lundazi	0.21	—	1
Lusaka	0.05	—	3
Mazabuka	Nil	—	—
Mongu	1.16	—	9
Mpika	0.91	—	3
Mporokoso	0.57	—	4
Mufulira	0.20	—	4
Mumbwa	1.16	—	4
Mwinilunga	4.23	—	11
Namwala	2.10	—	6
Ndola	0.88	—	5
Petauke	0.92	—	1
Senanga	1.52	—	7
Sesheke	2.06	—	5
Shiwa Ngandu	0.88	—	2
Solwezi	3.69	—	5

OCTOBER, 1939

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F.														PRESSURE MBS.			Cloud Tenths.	Sunshine hours.
		8.30 a.m.							Absolute.		No. of Days.									
		Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min.÷2.	Maximum. Date.	Minimum. Date.	Max. > 85°	Max. < 70°	Min > 65°	Min. < 40°	Mean of 24 hrs.	8.30 a.m. Station Level.	8.30 a.m 1200 gdm.	Mean of 24 hrs		
Beitbridge	1,486	76.5	66.1	60	13.0	90.5	66.7	78.6	106:25	58: 6	25	—	22	—	78.5	964.8	883.7	962.6	4.5	—
Bindura	3,700	72.8	62.5	56	12.0	85.3	61.4	73.4	91:v.	53: 2	13	—	—	—	—	—	—	—	1.5	—
Bulawayo	4,393	71.2	59.4	50	13.8	83.3	58.5	70.9	92:15	52:24	15	3	1	—	71.0	869.9	881.3	868.2	3.5	8.0
Chipinga...	3,685	69.9	62.3	57	8.6	80.5	59.1	69.8	91:25	53:13	3	2	3	—	—	893.4	882.8	—	2.5	—
Enkeldoorn...	4,808	70.2	58.4	50	12.6	81.7	56.5	69.1	89:15	50: 4	7	1	—	—	—	858.0	882.0	—	2.8	—
Fort Victoria	3,571	72.4	60.8	53	13.5	84.5	59.1	71.8	94:25	51: 1	17	1	1	—	71.7	895.8	881.8	893.9	2.8	—
Gwanda...	3,233	72.8	61.1	53	13.8	85.8	61.7	73.8	97:25	53:24	20	1	1	—	—	906.6	881.8	904.2	3.8	—
Gwelo	4,629	70.2	62.8	59	8.4	81.9	57.4	69.7	90:15	53:v.	10	2	—	—	68.6	862.8	881.2	—	3.1	—
Hartley	3,879	73.7	59.9	50	16.2	85.6	59.7	72.7	93:11	65:16	20	—	—	—	72.3	885.7	881.2	—	2.9	—
Inyanga	5,503	69.6	55.8	44	15.0	74.1	50.9	62.5	81:v.	42: 5	—	3	—	—	—	—	—	—	2.4	—
Marandellas	5,453	68.0	56.3	47	12.4	77.9	56.1	67.0	85:11	49: 4	—	3	—	—	66.1	—	—	—	2.9	—
Miami	4,093	73.3	60.9	53	14.8	83.7	59.5	71.6	89:v.	49: 5	11	1	—	—	71.2	878.9	880.9	876.8	1.7	—
Mt. Darwin...	3,179	74.5	62.9	56	13.7	86.7	62.4	74.5	93:16	50: 1	22	—	5	—	—	—	—	—	2.6	—
Mount Nusa	6,668	58.1	52.6	47	5.2	66.0	50.7	58.4	74:25	44: 4	—	21	—	—	57.0	803.0	882.4	—	4.9	—
Mtoko...	4,136	71.4	59.8	52	13.0	80.6	60.6	70.6	87:25	54: 5	3	1	1	—	70.0	878.5	882.1	876.9	2.1	—
New Year's Gift ...	2,690	73.0	63.7	58	11.4	85.6	59.4	72.5	96:25	48: 1	13	—	—	—	—	—	—	—	—	7.9
Nuanetsi	1,547	76.6	68.3	64	11.0	91.7	62.1	76.9	108:25	51: 1	25	—	6	—	—	962.7	883.1	—	3.8	—
Que Que...	3,999	71.8	61.2	54	12.1	85.8	60.2	73.0	93:11	54: 1	20	1	2	—	72.4	882.3	881.5	880.8	3.3	—
Rusape	4,648	70.3	59.2	51	12.2	80.3	55.3	67.8	88:17	48: 5	3	1	—	—	67.6	—	—	—	3.0	—
Salisbury	4,831	69.8	58.1	49	12.8	80.7	57.7	69.2	88:11	50: 1	3	—	—	—	69.1	856.8	881.4	855.2	2.4	7.7
Sinoia	3,795	74.8	63.1	55	14.4	86.2	57.7	71.9	94:11	46: 2	20	—	1	—	—	—	—	—	3.0	—

OCTOBER, 1939 (continued)

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F. 8.30 a.m. Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min.÷2.	Absolute. Maximum. Date.	Minimum. Date.	No. of Days. Max. > 85°	Max < 70°	Min. > 65°	Min. < 40°	Mean of 24 hrs.	PRESSURE MBS. 8.30 a.m Station Level.	1200 gdm. 8.30 a m	Mean of 24 hrs	Cloud Tenths.	Sunshine hours.
Stapleford	5,304	63.4	57.3	54	6.5	71.9	51.4	61.7	80:26	37: 1	—	9	—	2	—	—	—	—	4 3	—
Umtali	3,672	69.3	61.2	57	9.1	82.9	59.4	71.2	96:25	51: 1	16	3	—	—	69.7	893 9	882.8	892.2	4.2	—
Wankie	2,569	80.9	66.1	57	21.2	96.5	70.7	83.6	104:15	64: 3	28	—	27	—	—	926.2	880.7	—	2.8	—
Abercorn	5,458	71.3	58.1	47	13.9	83.7	59.0	71.4	88:30	56: 5	6	—	—	—	69.9	837.4	880.1	—	2.5	—
Broken Hill	3,911	74 4	61.3	52	15.7	86.9	64.8	75.8	92.16	60: 1	24	1	13	—	74.9	884 1	880.3	—	3.4	—
Fort Jameson... ...	3,815	76.1	61.4	52	18.8	86.9	67.3	77.1	91.11	62: 1	23	—	21	—	76.4	887.6	881.4	885 7	1.2	7.9
Fort Roseberry ...	3,830	72.7	62.8	57	11.7	86.3	60.3	73.3	90:v.	52: 3	21	-	2	—	73.1	—	—	—	—	—
Kasempa...	4,500	67.2	60.8	57	7.1	84.0	59.3	71.7	92:16	45: 3	15	—	—	—	—	—	—	—	—	—
Livingstone...	3,051	75.7	64.3	58	14.0	90.5	64.6	77.6	98:15	58: 1	24	—	15	—	[illegible]	907.1	879.9	934.8	4 1	—
Loangwa Bridge ...	1,330	81.3	66.0	57	—	98.5	71.7	85.1	105:16	62: 1	29	—	29	—	85.2	—	—	—	—	—
Lundazi	3,590	76.3	65.5	59	13.7	86.4	58.2	72.3	93:26	50: 1	17	—	1	—	72.0	—	—	—	0.8	—
Lusaka	4,193	73.3	59.7	49	16.0	84.9	63.9	74.4	91:16	59: 5	19	—	6	—	—	874.8	880.1	—	3.9	7.4
Mankoya	3,670	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mongu	3,481	72.8	62.3	55	12.5	89.6	64.5	77.0	97:11	59:14	22	—	12	—	75.8	896.4	879.5	—	4.6	—
Mpika	4,620	71.7	60.3	53	13.0	84.8	61.1	72.9	89:17	55:16	12	—	—	—	72.2	862.1	880.4	—	2.6	-
Msoro	3,000	81.2	66.0	57	23.0	95.9	65.4	80.6	100:18	59:13	31	—	13	—	81.7	—	—	—	—	—
Mumbwa...	3,500	72.1	61.0	54	12.9	88.3	57.6	72 9	98:13	46: 3	22	1	2	—	—	—	—	—	—	—
Mwinilunga...	4,450	65.8	62.2	60	4.1	84.4	58.4	71.4	90: 9	50: 1	18	—	—	—	—	—	—	—	—	—
Ndola	4,190	72.9	61.0	53	14.0	87.3	60.8	74.1	92:11	56: 1	24	—	—	—	—	875.5	880.5	872.6	2.5	—
Chileka	2,600	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Rainfall in October, 1939, in Hundredths of an Inch. Telegraphic Reports.

Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	Normal
1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	3	8	13	...	...	11	15	...	18	8	...	9	...	...	...	94	85
2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	4	...	1	...	2	13	...	...	39	4	...	65	88
3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	12	2	...	...	2	...	...	91	12	...	16	7	2	144	140
4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	7	2	...	...	...	23	3	12	36	2	5	3	105	...	199	96
5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	29	...	2	5	2	...	1	3	...	1	10	18	27	101	56
6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	5	...	...	...	...	31	15	...	13	11	3	...	104	3	186	104
7	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	24	23	13	46	2	15	19	57	2	201	93
8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	74	...	25	20	10	12	16	13	...	170	93
9	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	2	6	...	...	...	17	...	13	21	27	21	4	21	...	132	61
10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	96	66	3	25	29	...	...	222	59
Mean	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	1	3	8	...	1	3	16	4	13	20	6	9	12	33	5	136	83

Rhodesia Weather Bureau.

NOVEMBER.

PRECIPITATION.

Station.	Inches.	Normal.	No. of days.
Beitbridge	4.99	2.06	11
Bindura	6.09	3.21	10
Bulawayo	4.86	3.23	12
Chipinga	3.84	4.33	13
Enkeldoorn	4.24	3.55	9
Fort Victoria	4.04	2.86	11
Gwaai Siding	0.99	2.79	8
Gwanda	4.98	2.37	13
Gwelo	5.37	3.70	10
Hartley	4.47	3.76	12
Inyanga	8.57	3.92	15
Marandellas	6.17	4.09	12
Miami	4.11	3.25	11
Mount Darwin	2.68	3.34	7
Mtoko	3.26	3.13	10
New Year's Gift	4.63	2.95	7
Mount Nuza	6.85	8.44	16
Nuanetsi	5.78	2.54	10
Plumtree	5.41	2.82	11
Que Que	2.84	3.01	7
Rusape	5.68	4.58	11
Salisbury	5.87	3.65	12
Shabani	2.12	1.88	8
Sinoia	6.51	3.50	12
Sipolilo	6.33	3.17	10

Station	Inches.	Normal.	No. of days.
Stapleford	5.77	6.80	18
Umtali	3.77	3.84	13
Victoria Falls	3.47	2.39	12
Wankie	2.88	2.02	12
Balovale	7.82	—	15
Broken Hill	4.69	—	12
Chinsali	3.37	—	7
Fort Jameson	2.19	—	9
Fort Roseberry	8.55	—	14
Isoka	0.75	—	5
Kaloma	5.11	—	11
Kanchindu	2.52	—	12
Kasama	6.60	—	18
Kasempa	5.43	—	15
Luangwa	2.06	—	10
Livingstone	3.07	—	12
Lundazi	1.72	—	9
Lusaka	3.34	—	11
Mankoya	13.83	—	17
Mazabuka	4.76	—	12
Mkushi	5.69	—	10
Mongu	8.18	—	17
Mpika	5.58	—	8
Mporokoso	5.83	—	19
Mumbwa	7.27	—	16
Namwala	1.14	—	10
Ndola	7.24	—	17
Sesheke	1.64	—	4
Shiwa Ngandu	5.28	—	14
Solwezi	9.52	—	16

NOVEMBER, 1939

Station	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F.														PRESSURE MBS.			Cloud Tenths.	Sunshine hours.
		8.30 a.m.							Absolute.		No. of Days.									
		Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min.÷2.	Maximum. Date.	Minimum. Date.	Max > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hrs.	8.30 a.m. Station Level.	8.30 a.m. 1200 gdm.	Mean of 24 hrs		
Beitbridge	1,486	74.5	66.5	62	10.1	87.6	65.2	76.4	99:23	58:20	19	1	14	—	76.0	963.5	882.3	961.5	4.8	—
Bindura	3,700	71.1	63.5	59	9.0	81.3	62.3	71 8	90:24	56:24	6	1	6	—	—	—	—	—	5.0	—
Bulawayo	4,393	69.2	60.4	54	9.7	81.0	58.0	69.5	89:24	49:16	10	1	3	—	69.1	868.8	880.2	867.3	5.8	8.0
Chipinga...	3,685	—	—	—	—	77.9	59.2	68.5	89:12	52:20	3	3	4	—	67.3	892.0	881.5	—	5.1	—
Enkeldoorn...	4,808	68.9	60.6	55	9.1	79.8	58.2	69.0	89:23	49:20	5	2	1	—	—	857.1	880.7	—	5.0	—
Fort Victoria	3,571	71.4	61.9	56	11.0	82.1	59.5	70.8	92:23	49:20	13	3	5	—	70.0	895.2	881.2	893.7	5.4	—
Gwanda...	3,233	71.5	62 2	56	11.0	82.7	61.3	72.0	92:24	52:21	13	2	7	—	71.4	905.4	880.7	—	5 7	—
Gwelo	4,629	68.9	60.9	56	8.8	79.9	57.8	68.9	90:23	48:20	5	1	—	—	67.7	861.8	880.3	—	5.0	—
Hartley	3,879	71.5	63.1	58	9.9	82.6	60.7	71.7	89:23	52:20	12	—	2	—	—	885 0	880.6	—	5.5	—
Inyanga	5,503	67.9	59 9	54	8.7	74.3	54.5	64.4	81:12	44:21	—	6	—	—	—	—	—	—	5.4	—
Marandellas	5,453	66.2	59.6	55	7.2	74.2	56.8	65.5	81:12	49:20	—	6	—	—	64.0	—	—	—	5.7	—
Miami	4,090	70.4	63.6	60	8.0	80.3	61.2	70.8	88·24	55:v.	6	2	2	—	69.7	878.5	880.5	876.6	6.1	—
Mt. Darwin...	3,179	72.5	64.8	61	9.5	83.0	62 9	73.0	93:24	57:v.	14	1	6	—	72.3	—	—	—	5 5	—
Mount Nuza	6,668	58.9	55.4	53	3.4	65.3	51.5	58.4	76:14	43: 8	—	21	—	—	57.6	801.9	881.1	—	7.2	—
Mtoko...	4,136	69.8	62.1	57	8.8	79.3	61.3	70.3	89:13	54:20	4	2	5	—	69.5	877.6	881.2	876.0	5.0	—
New Year's Gift ...	2,690	73.9	65.7	61	10.2	84.6	61.2	72.9	94:12	54:20	15	2	5	—	—	—	—	—	—	6.9
Nuanetsi	1,547	74.5	67.1	63	9.2	86.8	63.0	74.9	99:12	54:20	21	3	12	—	—	961.6	881.9	—	5.8	—
Que Que...	3,999	70.7	63.1	58	8.8	83.4	61.0	72.2	91·24	52:20	14	—	3	—	71.4	881.3	880.5	879.6	5.7	—
Rusape	4,648	69.3	61.4	56	9.0	77 5	57.5	67 5	85:v.	49:20	—	6	—	—	67.1	—	—	—	5.6	—
Salisbury	4,831	66.2	58.9	54	7.7	75.3	56.5	65 9	85:23	53:21	1	3	1	—	67.4	856.0	880.8	854.4	5.9	6.9
Sinoia	3,795	71.8	65.4	62	7.6	81.3	60.6	70.9	89:24	52:22	8	—	4	—	—	—	—	—	6 5	—

NOVEMBER, 1939 (continued)

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F.														PRESSURE MBS.			Cloud Tenths.	Sunshine hours.
		8.30 a.m.							Absolute.		No. of Days.									
		Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min. ÷ 2.	Maximum. Date.	Minimum. Date.	Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hrs.	8.30 a.m. Station Level.	8.30 a.m 1200 gdm.	Mean of 24 hrs		
Stapleford	5,304	64.1	59.7	57	4.8	71.1	51.9	61.5	81:14	40:20	—	10	—	—	—	—	—	—	6.1	—
Umtali	3,672	69.0	63.4	60	6.6	80.9	60.5	70.7	91:14	54:v.	8	1	3	—	69.0	892.5	881.6	891.1	6.5	6.4
Wankie	2,569	78.4	68.5	64	13.0	94.6	67.6	81.1	101.25	64:v.	30	—	24	—	—	925.7	880.1	—	5.0	—
Abercorn	5,458	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Broken Hill	3,911	70.8	64.7	61	7.3	81.8	63.4	72.6	87: 9	59:20	6	—	6	—	70.3	883.9	880.1	—	7.4	—
Fort Jameson... ...	3,815	75.0	65.3	60	12.1	86.0	66.5	76.3	95:26	62:20	19	—	18	—	74.4	887.1	880.8	885.4	4.5	6.4
Fort Roseberry ..	3,830	69.9	64.8	62	6.0	82.3	62.9	72.6	86: 1	60: 2	2	—	1	—	71.0	—	—	—	—	—
Kasempa...	4,500	66.6	64.3	63	2.7	79.7	60.7	70.2	86:28	56:12	1	—	—	—	—	—	—	—	—	—
Livingstone...	3,051	73.8	67.9	65	7.5	87.7	64.8	76.2	93:23	60: 9	21	—	13	—	74.3	906.6	879.2	904.7	6.4	—
Loangwa Bridge ...	1,330	80.4	70.5	66	13.7	94.2	72.6	83.4	104:13	63.21	26	—	28	—	82.3	—	—	—	—	—
Lundazi	3,590	74.7	66.9	63	9.9	87.8	62.6	75.2	92.12	59:26	27	—	2	—	73.3	—	—	—	—	—
Lusaka	4,193	70.5	63.5	59	8.1	80.6	62.6	71.6	87:26	57: 8	4	—	3	—	—	874.4	879.7	—	7.9	—
Mankoya	3,670	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mongu	3,481	70.8	66.6	64	5.2	83.9	64.3	74.1	91: 9	61:12	13	—	7	—	71.6	896.5	879.4	—	6.9	5.6
Mpika	4,620	71.1	64.2	61	8.0	82.2	61.7	71.9	88:13	57:26	5	—	1	—	70.5	862.3	880.6	—	6.3	—
Msoro	3,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mumbwa...	3,500	70.3	65.0	63	6.4	82.9	60.8	71.8	87:13	50: 3	7	—	5	—	—	—	—	—	—	—
Mwinilunga...	4,450	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ndola	4,190	68.9	64.6	63	5.1	81.5	62.1	71.8	87: 2	59: 8	4	—	1	—	70.0	875.3	880.3	873.1	6.2	—
Chileka	2,600	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Rainfall in November, 1939, in Hundredths of an Inch. Telegraphic Reports.

Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total	Normal
1	...	...	11	41	35	...	...	...	7	...	...	3	8	68	123	6	...	...	...	...	...	...	...	12	34	91	25	13	5	...	482	276
2	...	...	1	26	11	8	...	...	...	...	...	...	18	42	50	17	...	...	...	...	...	...	...	...	...	91	31	43	28	10	376	266
3	...	...	29	2	40	9	...	...	...	...	...	...	15	123	51	56	11	...	3	...	...	...	...	...	...	64	...	3	19	1	426	449
4	...	...	6	2	7	1	...	5	...	...	...	2	14	63	59	5	...	...	...	...	...	...	...	...	49	159	4	7	49	2	434	341
5	...	5	40	36	12	3	...	...	...	24	34	2	...	1	70	10	...	...	...	...	...	...	...	8	65	21	7	20	29	5	392	245
6	...	...	1	...	16	...	49	...	6	6	...	...	28	33	2	13	7	...	...	...	...	...	...	...	14	39	31	63	36	82	426	355
7	...	...	5	9	44	10	1	2	5	...	...	1	20	146	17	15	53	8	...	...	...	...	...	...	1	1	86	119	31	16	590	429
8	...	...	4	1	27	72	2	...	11	...	...	...	1	102	25	45	106	11	11	...	...	...	...	...	...	...	118	41	30	80	687	363
9	...	1	37	11	15	22	5	...	...	...	...	...	3	40	3	47	37	18	7	...	...	...	...	...	...	35	115	24	31	38	489	311
10	...	...	1	...	15	35	1	...	...	...	...	...	...	103	3	51	...	...	...	...	...	...	...	...	...	...	16	48	1	23	297	329
Mean	...	1	15	19	21	9	7	1	3	5	6	1	11	56	49	19	14	3	1	...	...	...	...	4	23	54	42	38	26	22	450	311

Southern Rhodesia Veterinary Report.

NOVEMBER, 1939.

DISEASES.

No fresh outbreaks of scheduled diseases.

TUBERCULIN TEST.

Fifty-eight bulls, 42 cows and 36 heifers were tested upon importation, of which 6 bulls and 3 heifers showed a suspicious reaction and are being held over for a re-test.

MALLEIN TEST.

Seven horses, 28 mules and 2 donkeys were tested during the month. One horse from Natal gave a suspicious reaction and is being held over for a serological test.

IMPORTATIONS.

From the Union of South Africa.—Bulls 9, cows and heifers 78, horses 6, mules 28, sheep 2,040, goats 205, pigs 1.

From Bechuanaland Protectorate.—Sheep 203.

From South-West Africa.—Bulls 58.

EXPORTATIONS.

To Portuguese East Africa.—Cattle 120, donkeys 78, mules 18.

To Belgian Congo.—Cows 62, horses 1, donkeys 2.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom.—Frozen beef quarters (chilled quality), 10,562; frozen beef quarters (fair average quality), 898; frozen boneless beef quarters, 334; offal, 42,801 lbs.

To Northern Rhodesia.—Frozen beef carcases 66; frozen mutton carcases, 62; frozen veal carcases, 7.

To Belgian Congo.—Frozen beef carcases, 167; frozen mutton carcases, 12.

Meat Products from Liebig's Factory.

To Union of South Africa.—Corned beef, 3,624 lbs.; sausages, 26,381 lbs.

B. A. Myhill,
Chief Veterinary Surgeon.

FARMERS' WANTS.

Advertisements under this heading will be accepted from *bona fide* farmers wishing to effect sale, purchase or exchange of produce, live stock or farm implements, at a minimum charge of 2/6 per insertion of 20 words. Extra words will be charged for at the rate of 1/- for every 10 words. The charges for these advertisements must be prepaid, and advertisements will appear on this page each month.

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THE RHODESIA

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, *Salisbury.*

Storm Water Pits or Dams.—The following letter addressed to the Chief Irrigation Engineer by W. H. Dodd, Esq., Weston Park, Banket, will be of interest to many farmers:—

"Some work I have been doing lately in connection with the control of storm water may be of interest to you.

"A few years ago I dug a series of pits in my storm drains, hoping the pits would hold up the water during the storm and the water soak away before the next storm. These acted for the first storm or two, but soon silted up and retained the water.

"Last season I threw up a number of earth dams at the exit of storm drains and across vleis where dongas were forming. In the wall I either built a brick tunnel 3½ inches by 1½ inches wide, or put in 2 inch piping; these are left open, the object being for the dams to hold up all the storm water leaving a small stream of water escaping until the dam is empty and ready for the next downpour.

"So far all my work has been done by hand, the earth thrown up by shovels, and no tamping done. Care, however, has been taken to put in spillways and to have the walls at least 2 feet high.

"The advantages of this idea will be obvious to all who have a big volume of water to contend with during a storm."

Boron and Cotton Flower-buds.—Experiments recently carried out at the Georgia Experiment Station by Messrs. Holley and Dulin show that although a low Boron content does not seem to influence the growth and development of the cotton plant, it has a definite influence on the number of buds which develop and do not drop off. Grown in water cultures where the Boron could be accurately checked the presence of one-tenth part per million in the solution resulted in the average production of 53 buds per plant, of which, however, only 11 produced blooms. One part per million on the other hand produced 53 blooms per plant, although the initial production of flower buds was not any larger. The summary of the paper, published in the October, 1939, issue of the *Journal of Agricultural Research*, reads as follows:—"Water-culture studies of the boron requirements of cotton brought out the fact that this element is necessary for flower-bud development in this plant, and that flowering may be seriously limited by a supply of boron that is sufficient for fair vegetative growth. There is no evidence from these results that boron has any relation to flower-bud initiation in cotton."

Chillers for Bulawayo Show.—The following circular sent out by the Secretary of the Bulawayo Agricultural Society will be of general interest, although it applies to Matabeleland producers only:—

With reference to circular of the 5th September in which was set out a proposal by Mr. W. B. Dawson having for its ultimate object the hastening of maturation of steers for overseas export purpose, *viz.*:—

(1) At the 1940 Bulawayo Show Matabeleland producers will send a pen of 12 animals which have been weaned in 1939.

(2) Mr. Dawson will pay the railage. For the present the total payments for railage will be limited to £25. If the total railage should be in excess of £25, there will be a *pro rata* allocation.

(3) The animals will be for "exhibition" only, and the Show authorities will mark the animals in such manner as they deem proper.

(4) After the Show the owner will arrange the return of the animals to the home farm—the railway facilities allow free return.

(5) Ten of the animals out of each lot of 12 are to be produced again at the 1941 Show. By that time they should have reached the stage for disposal as chillers, and will be eligible for prizes which Mr. Dawson will donate.

The scheme has been approved by the Matabeleland Farmers' Union and by the Cattle Committee of the Bulawayo Agricultural Society. With a view, however, to widening its scope it has been agreed that the small producer should be given equal opportunity with the large producer and, therefore, entries from Matabeleland will be accepted from:—

Companies and Syndicates for 12 head, and

Small producers (owning less than 500 head) and

Feeders and agriculturists for 6 head.

In regard to age, it will suffice if permanent incisors have not yet appeared in the weaners on first inspection in September, 1940, and out of these 12 and 6, 10 and 5 respectively are to be available for the 1941 Show.

Furthermore entries, which should be addressed to the Secretary, Bulawayo Agricultural Society, will close on the 30th April, 1940.

It is the feeling of the donor that if this country is ever to establish itself as a reliable producer of prime beef, worthy of a price higher than that hitherto obtained by this country overseas, then hastening of maturity of steers cannot be confined to cattle breeders, but must be spread out so as to include growers of food. Agriculturists are, therefore, invited to obtain six weaners and to experiment in the direction which this scheme indicates.

The possibility that war conditions may prevent the holding of a Show in Bulawayo in September, 1940, is not to be allowed to interfere with the carrying out of this project, and in the event of there being no Show in 1940, the Agricultural Department will be asked to undertake on owner's ranch or farm the inspection and branding with ear tags marked "B.A.S." and numbered consecutively of competitors' weaners on or about 1st September, 1940. Thus companies and syndicates, or small producers, feeders or agriculturists, having entered their names by 30th April, 1940, should have 12 or 6 weaners, respectively, ready for inspection and branding by the 1st September, 1940, with a view to exhibiting 10 or 5 of them, respectively, by September, 1941. If war conditions in 1941 are still interfering with the holding of a Show, other arrangements will be made for bringing the exhibits together for competitive purposes, as well as for weighing each animal beforehand.

Notice to Farmers.—Soil and Water Conservation.—Farmers are advised that applications for visits should be sent in now, and in the case of soil conservation, they are requested to state the earliest date on which the work could be set out.

Increasing difficulties are being experienced each year in coping with the demands made for visits during the middle of winter and onwards.

Applications will only be considered when made directly through the Irrigation Department, Box 387, Salisbury, or

Box 566, Bulawayo, and farmers are particularly requested not to apply direct to an Engineer when on tour, or to a local Technical Assistant.

No charge is made for visits if carried out as part of an ordinary tour, provided they do not occupy more than one day, but farmers are advised that the number of free visits which can be made to any one farm during each year is strictly limited.

It is hoped that farmers will endeavour to co-operate with the Department by observing the above points, and preparing for the visit after being notified, so that disappointments may, as far as possible, be avoided.

Cleanliness Reminders for February and March.—In all lands weeds should be kept down to prevent the breeding of various crop pests.

Tobacco seed-beds should have been dug in by now and neighbouring weeds destroyed. If this has not yet been done, immediate attention will prevent the spread of further pests and diseases to the lands from this source. Immediate attention is in any case a wise measure if more seed-beds are to be put down next season. It is not good practice to allow unwanted seed-bed plants or weeds to flower or to continue harbouring pests.

Destruction of tobacco primings, etc., as advised in January, should be carried out. In order to maintain the efficiency of spraying and dusting equipment, such equipment should be thoroughly cleaned out before being set aside for later overhaul. Grading and other tobacco sheds should be cleaned out regularly and the refuse immediately burned or composted.

Cucurbits that have been "stung" and infested or fallen fruit, should be collected and destroyed at regular short intervals, preferably daily. The use of second-hand fruit boxes should be avoided by fruit growers (see these notes for May, 1939).

Screw-worm maggots removed from livestock should be killed without fail. Merely throwing them on the soft ground of the kraal and placing a foot on them does not necessarily destroy them. They should be burned, fed to poultry, or killed in some other way. Cutting the soiled wool from the hindquarters of sheep suffering from scour will help to prevent infestation by sheep maggot fly.

Agricultural cleanliness operations for these two months should not be postponed until the end of March, but should continue through the whole period.—*Cleanliness Aids Insect Control.*

Government Loans and Subsidies, etc.

FOR SOIL AND WATER CONSERVATION, GREEN MANURING AND ARTIFICIAL FERTILISERS.

It appears that large numbers of farmers are still unaware of the easy conditions under which loans and subsidies may be obtained and are also unaware of the conditions under which the Premier Portland Cement Company (Rhodesia) Ltd. provides supplies of cement at reduced rate for water conservation works.

It has been decided, therefore, as a result of the need for expansion of such works, stressed by the Soil Conservation Advisory Councils of Mashonaland and Matabeleland, to set out the general conditions briefly in bulletin form.

Irrigation Loans.—These loans are obtainable for any soil or water conservation works approved of by the Irrigation Department, such works including dams, weirs, canals, contour ridges and storm drains. Loans are also obtainable by Farmers' Associations or any other approved Committee or body of farmers, for the purchase of implements and plant for the construction of soil conservation works.

The application forms may be obtained either from the Director of Irrigation, P.O. Box 387, Salisbury, or from the Irrigation Engineer (Matabeleland), P.O. Box 566, Bulawayo.

Before applying for a loan it is very advisable that the scheme be first investigated by an Irrigation Engineer and farmers should apply for a visit to one of the two officials mentioned above. These visits are carried out free of charge if the time occupied by the Engineer on any one farm is not more than twenty-four hours, and if visits can be carried out during the course of a tour. Designs and estimates of costs are prepared by the Irrigation Department and the work itself pegged out, leaving the farmer in a sound position to proceed with the construction.

These loans are normally available under the following conditions:—

(*a*) Interest is charged at the rate of 4½% per annum on the amount of the loan outstanding and, if desired, the interest charges over a period not exceeding the three initial years, may be funded with the loan, no repayment of capital being necessary during such period.

(*b*) Repayment of the loan and interest may be made in annual instalments over a period not exceeding 17 years, the first repayment being due not more than three years after the loan is obtained. Should a farmer be prepared to commence repayment within any period less than the first three years, the repayment period may be extended up to a maximum of 20 years.

The actual period for repayment will depend on the amount of the loan and the purpose for which it is required.

(*c*) In the case of farms which are owned by the applicant, loans are secured by registration, in the office of the Registrar of Deeds, against the title deeds of the property concerned. Such registration is not published in the *Government Gazette*.

Alternatively, these loans may be secured on the personal security of two sureties who must be holders of immovable property in Southern Rhodesia, and such sureties are insisted on if the farm is heavily bonded to a private individual.

In the case of farms held under Agreement of Purchase from the Government, security is obtained by the applicant giving written agreement that title shall not be issued until the loan is repaid in full.

In the case of Crown land farms held under lease the cost of the work will be paid for out of Government funds, provided the leaseholder agrees to having his annual rental increased by 4% of the capital outlay involved. When the farm is alienated later under Agreement of Purchase terms the works will be regarded as a permanent improvement and their cost, plus interest at 4% per annum, will be repayable over the period of the Agreement.

(*d*) As soon as a loan is approved and the applicant is ready to commence the work, one-fifth of the loan can be paid out to him to make a start. The balance of the loan is paid out on certificates issued from time to time by an Irrigation Engineer, stating that the work is being satisfactorily carried out and that the value of the completed portions is not less than the instalments required.

(*e*) Cement required on works for which a loan has been obtained is procurable at 2s. 6d. per pocket (95 lbs.) through the Director of Irrigation or Irrigation Engineer (Matabeleland).

Tools and plant purchasable with the loan may also be obtained through these officials.

(*f*) If a loan is obtained for water conservation works, the amount which normally would be repayable may be reduced by a rebate. The conditions applying to such rebates are set out in this bulletin under the heading "Subsidies on Water Conservation Works," paragraph (*e*).

Green Manuring and Artificial Fertiliser Loans.—These loans are obtainable from the Land and Agricultural Bank of Southern Rhodesia and are made under conditions recommended by the Soil Conservation Advisory Councils. The loans are made for the purpose of meeting the cost of green manuring and fertilising of lands which have been badly eroded and which have subsequently been suitably protected by contour ridges, but which are judged to be incapable of producing a cash crop without this treatment.

Application forms can be obtained from the Land Bank, and when completed must be submitted in the first place to the Secretary, Department of Agriculture and Lands.

All applications are subsequently considered by the Finance Sub-Committee of the Soil Conservation Advisory

Councils, and if recommended are then passed to the Manager of the Land Bank.

Applicants are strongly recommended to obtain, from their local Soil Conservation Committee, a brief report certifying that the lands to be treated are suitably protected by soil conservation works, and are in need of either or both green manuring and fertilising.

The conditions under which these loans are made are:—

(*a*) Loans require, in the first instance, to be recommended by an officer of the Department of Agriculture, or by the local Soil Conservation Committee, or by both.

(*b*) The loans are made on the best security available to the Land Bank, subject to the applicant being satisfactorily reported on.

(*c*) Interest is charged at the rate of 5% per annum, payable half-yearly in arrear, the first payment of interest being due six months after the date of issue of the loan.

(*d*) The capital is required to be repaid in six half-yearly instalments, the first instalment being due 3½ years after the date of issue of the loan.

(*e*) The maximum amount of a loan in any one year for any individual farm is £100.

Subsidies on Water Conservation Works.—In order to encourage the construction of water conservation works, subsidies or rebates are granted in respect of a portion of the cost of such work.

Applications for these subsidies or rebates must be made in the first instance to the Director of Irrigation or the Irrigation Engineer (Matabeleland), as an inspection of the work by an Irrigation Engineer is necessary in order that he may submit the necessary certificate.

The conditions under which these subsidies and rebates are obtainable are as follows:—

(*a*) They will be granted only in the case of schemes involving the storage of water. They WILL NOT be granted in respect of pumping schemes, ordinary irrigation diversion schemes or schemes for the exploitation of underground water supplies.

(*b*) The amount of the subsidy or rebate is 25% of the actual cost of the storage work and is limited to a maximum of £62 10s. 0d. per individual farm.

(*c*) Subsidies or rebates will only be paid on completion of works approved by the Irrigation Department after an inspection and valuation. If the inspection is carried out by an Engineer during the course of an ordinary tour no charge is made, but should an applicant desire a special visit for the inspection, the cost of such a visit is deducted from the subsidy or rebate granted.

(*d*) Subsidies or rebates apply ONLY to approved water conservation works, which were in progress on the 1st January, 1936, or have been constructed since then.

This grant of subsidies or rebates applies only up to the 31st December, 1940, and consequently the construction of schemes by persons desirous of obtaining such rebates must be completed before this date.

(*e*) In cases where irrigation loans have been granted for the construction of storage works, the total amount of the loan, which otherwise would be repayable, will be reduced by the amount of rebate granted.

Supply of Cement at Reduced Rates.—Arrangements have been made by the Premier Portland Cement Company (Rhodesia) Ltd. whereby farmers who do not desire a loan and are willing to pay cash for the cement required, may obtain cement at reduced rates and on completion of the work will receive a rebate from the Cement Company.

The following conditions apply to obtaining cement in this manner:—

(*a*) A cheque in favour of the Premier Portland Cement Company (Rhodesia) Ltd. must first be sent to the Director of Irrigation or the Irrigation Engineer (Matabeleland).

This cheque must cover the initial cost of the cement at initial rate, plus railage charges if the cement is to be consigned to a siding where the sender is forced to prepay the railage charges.

If the cement is consigned to a station where prepaid railage charges are not necessary, the cement can be despatched "carriage forward" and the farmer will then have to pay the railage charges on receipt of the cement.

(*b*) The initial rates are 3s. 0d. per pocket (95 lbs.) for quantities less than 50 pockets, and 2s. 10d. per pocket for lots of 50 pockets and over.

The minimum quantity which can be obtained is 24 pockets—and this quantity must be on one order and in one delivery.

(*c*) After an inspection of the works by an Irrigation Engineer, a certificate is issued to the Cement Company to the effect that all the cement has been utilised in the construction of water conservation works only. The Cement Company will then forward the rebate to the farmer.

The amount of the rebate is the difference between the price initially paid and a reduced price of 2s. 6d. per pocket, thus making the actual final cost of the cement 2s. 6d. per pocket.

Loan on Ditching Implements.—Arrangements have been made whereby Farmers' Associations, approved groups of farmers or individual farmers, may obtain ditching implements on loan from the Government, free of hiring charge, for the construction of contour ridges.

The conditions under which these implements are available are as follows:—

A. *To Farmers' Associations or Groups of Farmers:*—

(1) The Farmers' Associations or group of farmers must make itself responsible for the upkeep and maintenance of the implement.

(2) The Association or group must render monthly returns in duplicate to either the Director of Irrigation or Irrigation Engineer (Matabeleland) giving the time spent and the length of ridges constructed on each farm.

(3) The Association or group is responsible for the delivery of the implement from either Salisbury or Bulawayo to its centre and for its eventual return.

(4) The choice of type of implement is left to the Association or group.

B. *To Individual Farmers*:—

(1) This shall apply only to areas in which no Farmers' Association exists.

(2) The farmer must render returns either to the Director of Irrigation or the Irrigation Engineer (Matabeleland) giving the time spent and the length of ridges constructed on his farm.

(3) The farmer must make himself responsible for the removal of the implement from Salisbury or Bulawayo and for its return in good condition, exclusive of fair wear and tear.

(4) When available, the farmer has the choice of the following implements:—

Salisbury: Lockie, Morris and Martin ditchers.

Bulawayo: Dam scraper, Martin ditcher or Morris heavy duty ditcher.

(5) The period during which an implement may be made use of by a farmer shall not exceed 14 days, unless written permission is obtained from either the Director of Irrigation or the Irrigation Engineer (Matabeleland). Such extensions will depend on the number of applications outstanding.

Low Birth Rate of Calves and Calf Mortality.

By B. A. Myhill, M.R.C.V.S., Chief Veterinary Surgeon.

With a view to obtaining a survey of the position in the Colony in regards to the above matters, a circular letter was addressed to all field officers of the Veterinary Department with a request that the following information be supplied:—

(1) Average percentage of calf crop on all farms and ranches in their area.
(2) Whether abortion exists, and if so, to what extent.
(3) The percentage of bull power used.
(4) Number of bulls suspected of being sterile.
(5) Mortality in calves up to six months.

The information obtained from stockowners cannot in all cases be accepted as reliable, nevertheless sufficient data is available for the purpose of the investigation. An endeavour has been made to analyse the returns and to arrive at conclusions to account for the very frequent unsatisfactory percentage increase and calf mortality. These reasons may be summarised as follows:—

(*a*) Drought conditions.
(*b*) Indifferent animal management.
(*c*) Genital diseases.
(*d*) Diseases of young calves.

Drought Conditions.—The lengthy periods of drought experienced in recent years undoubtedly proved to be an important factor in the low percentage of calves produced. The resulting inanition due to the low feeding value of the veld reduces the animal's breeding capabilities.

The figures reported for well managed dairy herds, where the animals are suitably fed, generally show a satisfactory calf increase, often as high as 80%.

Interesting facts are provided by the figures submitted by one large ranch, which demonstrate the important influence drought conditions bear on the calf crop. During the year 1926 the percentage of gross calving amounted to 72%; during 1927, described as a bad drought year, the percentage dropped to 57. During the following years to the year 1935, the calf crop averaged 45%, the fall being attributed to the effects of drought complicated by contagious abortion. The ranch experienced its worst drought during 1936 when the calf crop was the lowest on record, *viz.*, 24%. During 1937, described as a good pastoral year, the average increased to 54.3%. It is reported that as a result of the bountiful rains of 1938-1939 the present year's calving is proving quite satisfactory.

Indifferent Animal Management.—The following are given as contributory causes for the low average calf crops:—

(1) Insufficient provision for winter feeding.

(2) Breeding from aged animals.

(3) Overwork, and lack of attention, for the bulls.

(4) Lack of system in weaning.

(5) Breeding from immature heifers.

Genital Diseases.—(*a*) *Contagious Abortion.*—It is difficult to arrive at any definite conclusions in regard to the extent to which contagious abortion is responsible for a low calf crop. The disease is present in practically all districts throughout the Colony and from reports received it would appear that, with the exception of the first wave of infection, particularly on the larger ranches when an appreciable reduction in the calf crop may result, generally it is not considered to be a major factor. The disease has a tendency to wear itself out, and although cows continue to show a positive reaction to the agglutination test, they give birth to fully developed calves. Further investigation is, however, necessary to ascertain to what extent it is the cause of small calf crops.

(*b*) *Contagious Vaginitis.*—Although prevalent in the Colony, it is questionable whether this disease plays any part in causing sterility.

(*c*) *Trichomoniasis.*—Up to the present this disease has not been diagnosed in Southern Rhodesia.

Mortality of Young Calves.—The effect of the mortality amongst young calves on the general percentage increase in herds must be considered and may be attributed to the following conditions:—

(*a*) Totally inadequate food supplies amounting often to semi-starvation.

(*b*) Bad hygienic conditions, particularly in dairy herds —a predisposing cause to such diseases as White-scour and Calf diphtheria.

(*c*) Tick-borne diseases.

(*d*) Quarter Evil.

(*e*) Internal parasites.

(*f*) Losses due to carnivora.

Mortality due to most of the above conditions could be reduced considerably under better methods of management.

The following is a summary of the reports received from District Veterinary Surgeons:—

Veterinary District "A":

(*a*) *Calf Percentage.*—The average calf crop shown by the figures returned is 57.5%. On well managed farms this average reaches about 65%, dropping to 45% where little attention is paid to the cattle. In some of the dairy herds, where suspected sterility of the cows has been very closely investigated by the Department, the figures submitted are the highest, showing up to 80-100% calf crops.

(*b*) *Bull Power.*—The average is 2.5%, which is sufficient provided all bulls are young and active, but in many cases where two bulls are kept running with one hundred or more cows, one of these bulls is old, often from 8-10 years of age. The survey gives the impression that where young active bulls are used, the calf crop is highest, leading one to believe that the use of old bulls may frequently account for small calf crops.

(*c*) *Calf Mortality.*—Average percentage 12.6%, varying from 70% to nil, *the former figure on those farms where the cream cheque is the most important item.*

(*d*) *Sterile Bulls.*—Throughout the district, seven bulls are suspected of being sterile.

Veterinary District "B":

(*a*) *Calf percentage.*—Average 55%, varying between 45 and 65%.

(*b*) *Bull Power.*—Average 2.1%, varying between 1% and 6.5%.

(*c*) *Calf Mortality.*—15 to 20%, being much higher than in any other Veterinary district. Losses are due principally to Whitescour, Sweating Sickness and Calf diphtheria.

(*d*) *Sterile Bulls.*—Nil; any suspected have been slaughtered.

Veterinary District "C":

(*a*) *Calf Percentage.*—Under ranching conditions about 50%, but on farms were herds are small, 65%.

(*b*) *Bull Power.*—No average can be given, the number of bulls used varies greatly and this question does not appear to have received the attention it should.

(*c*) *Calf Mortality.*—Average 5%, but in dairy herds very much higher, due to bad sanitary conditions, under-feeding, exposure and general neglect.

(*d*) *Sterile Bulls.*—No figures obtainable.

Veterinary District "D":

(*a*) *Calf Percentage.*—Average 56.67%; under good management and with adequate feed as high as 94%.

(*b*) *Bull Power.*—4%, but actually not as high if the use of very immature and old bulls is taken into consideration.

(*c*) *Calf Mortality.*—15%.

(*d*) *Sterile Bulls.*—Nil.

Veterinary District "E":

(*a*) *Calf Percentage.*—Average 50%.

(*b*) *Bull Power.*—Not stated.

(*c*) *Calf Mortality.*—Not stated.

(*d*) *Sterile Bulls.*—Nil.

Malaria Control.

PUBLIC HEALTH DEPARTMENT BULLETIN No. 2.

During the rainy season it is opportune to draw attention to certain features of the epidemiology of malaria in Southern Rhodesia in the hope that anti-malarial measures may be rendered more effective.

The important mosquito carriers of malaria in the Colony are *A. funestus* and *A. gambiae*, and study of their habits has shown that they are relatively infrequent up to January but during the period January to May they are very prevalent. It is therefore recommended that anti-larval measures aimed at their destruction should be carried out from the beginning of December to the end of May.

The breeding places of these two varieties differ. *A. funestus* breeds usually in bodies of clear water that are more or less permanent in character and usually where shade from trees, shrubs or aquatic vegetation is present. Thus the edge of swamps, the weedy sides of streams, furrows and ditches, etc., should always be suspect. *A. gambiae*, on the other hand, is a sunshine loving mosquito breeding in small sandy or rock pools, rain puddles, animal hoof prints, borrow pits, isolated collections of water in roadside drains, etc., which are exposed to direct sunlight. Artificial collections of water such as cattle watering troughs and tins filled with rain water are not favoured by this type of mosquito.

It is possible by filling in borrow pits, by grading drains, by removing vegetation from the sides of water channels, to eliminate breeding places to some extent, and where possible this should be done, but in many cases some other method of control will be necessary. Oiling is perhaps the most generally useful of temporary methods, but to be successful it demands the use at regular intervals of an efficient anti-larval oil.

Oils vary considerably in their spreading and larval-killing properties and mixtures of various types of oils which have been specially compounded for the purpose are recommended in anti-larval work. These can be obtained locally.

The most satisfactory method for use in this country is to spray the oil on breeding places with a portable type of spray-pump, such as the "Four-Oaks" pattern. This enables the sides of streams and ditches, where vegetation affords shelter and shade to *A. funestus* larvae to be adequately dealt with, while the small isolated pools which *A. gambiae* prefers can also be rapidly treated.

Spraying should be done once a week at least, and to make for efficiency a definite spraying routine should be laid down. It is advised that all possible breeding places within a half mile radius of the area which it is desired to protect should be oiled, and to do so effectively the area to be treated should be divided into six sectors, each of which is oiled on a particular day of the week and on that day only. By so doing it is comparatively easy to check the efficiency of the oiling and, should live larvae be found in any sector two days after oiling, alteration in personnel or technique is called for. A rough indication of the adequacy of oiling is afforded by the condition of marginal vegetation in streams which should appear withered and burnt.

Arrangements should be made to have the oil transported in four-gallon drums to a central point in the sector to be oiled, as much time may be lost by oilers returning an unnecessary distance to replenish their supplies. It is, in fact, advisable to have the oiler accompanied by one or more carriers if the work is to be done with expedition.

Water which is used for domestic purposes or for the irrigation of vegetables should not be oiled.

It may be raised as an objection against routine oiling that its value will be adversely affected by floods. Actually floods themselves are anti-larval agents and artificial flushes are used in many parts of the world in anti-malarial campaigns. Unfortunately, no dependence can be laid on the regularity of floods under natural conditions and, as regularity is essential in any anti-larval measure of a temporary nature, it is better to depend upon routine oiling rather than casual floods, which may only occur at intervals sufficient to allow one or more hatchings of mosquitoes to take place.

Protective measures against adult mosquitoes should also be actively adopted during the period December to May. It is probable that mosquitoes usually acquire and transmit infection in premises used as sleeping quarters. The source of infection is undoubtedly the native inhabitants, particularly the native children who, investigation has shown, carry a surprisingly large burden of infection from one season to the next. Municipalities, mines and similar organisations would do much to reduce the chances of European infection by nightly spraying of native huts and dwellings in compounds and locations with an insecticide containing pyrethrum. The habits of the malaria-carrying mosquitoes are such that the probabilities are that many infected mosquitoes would thereby be destroyed. Householders with native servants on the premises would do well to follow a similar routine.

In previous publications the Public Health Department has repeatedly stressed the value of the use of mosquito nets, insecticide spraying, keeping of rooms free from articles which afford protection to resting mosquitoes during the day, and the necessity of clearing away all excessive vegetation around the house. All are measures which demand no great expenditure of time or money and their value is undoubted.

Despite the fact that malaria is one of the greatest hindrances to our ordered progress, we are in many ways in a fortunate position compared with other countries similarly plagued. Here conditions over the greater part of the Colony are such that active transmission only takes place over a certain period of the year. We are now in that period and now is the time to take active measures against the mosquito carriers of the disease.

This pamphlet lays down the broad principles of anti-malarial control. It is hoped that it will be possible, shortly, to send qualified officers in turn to each locality in order to instruct local officials in the application of these principles to local problems.

Farming Calendar

MARCH.

FORESTRY.

Cultivation where necessary should be undertaken between the rows of trees planted out in previous months. If cultivation is carried out with the hoe, care should be taken not to pile earth round the base of the stems. New ground for next season's planting should be roughly broken up with the plough. Bulk plantings may be proceeded with during the month.

CROPS.

Plough under witchweed traps in time. Watch oats for rust, and, if badly infested, cut crop for hay as soon as weather permits. Ridge late potatoes, and if weather is dry prevent ridges from cracking, to check tuber moth infestation. Finish ploughing under all green manure crops while the ground is still moist enough to promote rapid decomposition. Cut silage crops and ensile. Cut out barren maize plants and feed to stock or ensile. Cut Sudan grass for hay to permit of final late growth for autumn grazing. Reap any crops that are ready, and plough the stubbles *at once*. Watch for ground nuts making second growth; reap, and when sufficiently dry, place in cocks with nuts inwards and cover the top securely. Watch the weather for hay-making and take advantage of fine spells. Towards the end of the month hay-making should normally be in full swing. Continue to plough all lands in succession immediately the crops are reaped for them. Vleis and irrigable lands should now be ready, or in process of being prepared, for winter crops. Early sowings of winter oats, barley or rye for green forage can be made. Allow any potatoes lifted to dry before storing them, but do not leave too long in the sun. Destroy witchweed and other noxious weeds. Continue to make all the kraal manure possible by throwing grass and litter into kraals, yards, etc. Begin to select in the field maize plants for seed purposes, and mark them with slips of coloured cloth. Press on with the breaking up of any virgin land which may have been stumped or cleared earlier in the year. Place orders for grain bags without delay. Early in the month silage pits should be cleaned out or, where necessary, new pits dug.

STOCK.

Cattle.—Arrangements for winter feed should be pushed on. For a well balanced winter ration, in addition to good quality veld hay, a succulent feed such as maize silage, majordas or pumpkins and a legume hay such as velvet beans, cowpeas or dolichos beans are essential. The milk supply will begin to decrease. In the case of cows rearing calves it 's often good policy in this month to cease milking cows and to allow the calves to get all the milk from now on. Slightly increase the amount of grain to the dairy cows and increase the proportion of protein concentrate in the dairy cow mixture to make good the usual loss of feeding value in the grass. Bullocks fattening on grass will do better for a daily ration on some succulent feed such as green mealies or sweet potato tops, unless a supply of green grass is still available.

Calves which are under two months old should be kept in and allowed to nibble at well-got hay; at the same time a little dry mealie meal and monkey nut cake will do them good and teach them to eat concentrates. An ample supply of clean water should be provided in the calf run.

Sheep.—Ewes should now commence lambing. Run the big udder ewes with lambs separate. If the grass has gone off the ewes and lambs should have access to some green feed for an hour or two daily. Continue dosing as for February. If hookworm is present dose now and keep ewes and lambs especially away from vleis.

DAIRYING.

This is usually the most favourable month of the year for dairy operations. Cooler nights are now in evidence, and there is usually little difficulty in maintaining a low temperature in the dairy and cheese-room. If elementary precautions are taken, all cream should be first grade, and first-class cheese should be made, as a gassy condition of the milk is rare. Dairy cows, unless they are very high producers, can go without extra rations, because the grass is now in seed and grazing is ample. The cheese storeroom is generally full of cheese, and care should be taken to turn the cheese regularly. The windows and doors should be opened at night and closed in the daytime. A little mould on the cheese will not affect its quality, but if the mould is excessive the cheese should be rubbed daily.

FLOWER GARDEN.

Flower seedlings for winter blooming should now be coming on, and should be planted out during showery or cloudy weather. Cuttings of carnations may now be made, and should be taken from selected plants which have borne the choicest blooms. The cuttings should be dibbled in half paraffin tins containing three parts sand to one of loam, and kept in a moist condition in a shady position sheltered from the winds. Make main sowing of winter-flowering sweet peas in a well-prepared and rich soil.

VEGETABLE GARDEN.

The sowing calendar is the same as that recommended for last month. Plant out from seed-beds cabbages and cauliflower; care should be taken during this month, as the end of the rainy season approaches, to dig with a fork all the ground in the garden. The heavy rains settle this down hard, and as soon as the dry weather begins the soil cracks and lets out all the sub-soil moisture by evaporation. As soon as the rains cease entirely it is advisable to go over the ground and fine down with a rake, leaving some three or four inches of quite fine soil to act as an earth mulch.

POULTRY.

The breeding pens should have all been mated up by now, as the first chicks should be out by the beginning of April. Much more care should be used than is usually the case when selecting birds for breeding. Only the very best, *i.e.*, the strong, healthy, vigorous ones from the best layers, should be chosen. A pamphlet on "Selection and Mating for Improvement" can be obtained on application to the Editor or the Poultry Expert. This deals fully with the subject. Always keep an eye on the male bird; many are apt to get thin and run down in health, due to their allowing their mates to eat all the food. Such birds are better breeders than those that chase their mates away from the food. Every male that is being bred from should be given a good meal by himself each day, to ensure health and vigour. The incubator should be thoroughly overhauled, cleaned and disinfected before the eggs are put in.

The Bed-Bug and a New Aid for its Control.

WITH SPECIAL REFERENCE TO NATIVE QUARTERS.

By M. C. Mossop, M.Sc., Entomologist.

SECTION I. THE BED BUG.

Bed bugs infest most native rooms in Southern Rhodesian towns. Many natives state, however, that the pests are seldom troublesome in the huts of their villages and kraals. This may be wholly true, it may vary according to the tribe or local conditions, or the statement may merely be, as in the case of the white men, the result of an entirely unnecessary and foolish reluctance to admit the presence or even the suspected presence of bed bugs.

But, like the white man, the native will describe what others do to combat or avoid the pest. A grass hut may be either burned or be plastered with mud in an attempt to imprison the insects. In some kraals the foliage and stems of certain bushes are placed under the sleeping-mats and are said to trap the bugs when they attempt to reach the sleeper. The bugs can apparently be found sticking to the foliage of these bushes next morning. The bushes are stated to be effective for only a day or two.

Two bushes of this kind are known to the natives as "Dapatsikidzi" and "Ziname." Specimens said to be examples of Dapatsikidzi proved to be *Pseudarthria Hookeri*, Wight & Arn. (family Leguminosae), whilst specimens brought in as Ziname were *Laggera alata*, Sch.-Bip (family Compositae).

The leaf of Dapatsikidzi feels distinctly sticky on its upper surface, but the sticky feeling is not retained afterwards on a finger that has been pressed against it. The hairs on this surface are recurved at their tips, to form a very fine and pointed hook. These hooks are believed to be the cause of apparent adhesiveness when a leaf is placed with this surface against a piece of cloth or the skin of the finger. Through a miscroscope they can, when in this position, be seen to be engaged with the fibres of the cloth or with the surface of the skin. The hairs are sometimes pulled from a leaf when the object which they are holding is pulled away. The under surface of the leaf is densely covered with longer and finer hairs than those on the upper surface and produces no sensation of stickiness.

The leaf of Ziname, on the other hand, feels sticky on both surfaces and leaves a distinctly sticky feeling on a finger that has pressed it. Each hair has a small globule of a gummy secretion on its tip and the leaf surface itself has a sticky appearance.

In laboratory tests, both old and young bugs were trapped when placed on the upper surface of Dapatsikidzi leaves, some being held there for weeks before they died. The shorter hairs appear to be the more effective. Three weeks after being trapped, one bug moulted and was trapped on the leaf beside its cast skin. Ziname leaves, however, were able to retain only young bugs. On being confronted with this fact, a native stated that Ziname is repellent to the bugs, but no repellent action on captive bugs was observed, nor does the leaf have an unusual or strong smell.

When the native leaves his kraal and goes to a mine or a town and lives in dormitories, in native rooms, or in municipal or similar "locations" or "compounds," the bed bug problem becomes more important to him. An estimate of the bed bug population in a new native dormitory at the Agricultural Experiment Station, Salisbury, that has been occupied for four months and in which the native occupants considered that there was but a moderate infestation, indicated that the number of bugs averaged more than fifty per native.

The reason for the comparative freedom from bed bugs enjoyed by natives in their home element cannot be given at present. A few observations suggest that the presence of earth floors, grass or mud walls, grass roofs, and the absence of whitewash or paint are not in themselves responsible, although these conditions may favour attack by enemies of the bugs. Or possibly the fires that frequently burn in the huts for cooking and heating purposes, or the smoke therefrom, may be in some way responsible. But this is mere speculation, not based on any observations. If it were correct it would be expected that the natives would have recognised it long ago.

Another possible but less likely reason is that natives in the kraals wash both themselves and their garments fairly frequently. The personal cleanliness of one's native servant in town is probably not exceeded by his personal cleanliness in his own home, but his less fortunate friends who are out of employment and who visit him frequently in his room do not have the same opportunities to keep themselves and their clothing clean. Perhaps the purpose of their visit is a wash or a night's lodging; in either case the bugs they may be carrying on their persons have an opportunity to infest the room and subsequently to breed there.

Whatever the cause, the fact cannot be contradicted that in sleeping quarters regularly occupied by natives in towns and on mines, bed bugs readily become established and multiply.

Identity and Habits.

Bed bugs belong to the Order Hemiptera, or true bugs. There are two species commonly met with in Southern Rhodesia, namely, *Cimex lectularius*, L., and *C. hemiptera*, Fabr. To the average victim the two species look alike. *C. lectularius* is the common bed bug of temperate climates and is by far the commoner species in Southern Rhodesia. *C. hemiptera* is found in tropical and sub-tropical regions and is represented by comparatively few specimens in the insect collection of the Department of Agriculture.

A detailed description of the bed bug is hardly necessary. Briefly, the adult is oval, flat, reddish-brown, and about a quarter of an inch long. Many people know it at a glance, while others will not admit to such familiarity, although they may recognise it if they see it under suspicious circumstances, having probably seen an illustration of it in the past. The adult is illustrated in figure 1. The immature stages are similar, though a fully fed young bug may have a more rounded appearance. Almost any native servant can produce a bed bug for examination during the summer months, either from his own quarters or from those of a friend.

The habits of the two species are much alike. Up to 200 or more eggs are laid in cracks and crevices in walls, furniture, mattresses, ceiling and floor. Even a slight depression in a wall may be chosen for the deposition of eggs. Eggs are not laid all at one time in a cluster, but are deposited from time to time.

The young bugs are ready to feed soon after they hatch. During their growth they moult five times, the stages between hatching and the first moult, and those between successive moults, being known as instars. The immature bugs are said to require at least one meal in each instar. Feeding takes several minutes if a full feed is taken, and results in a considerable swelling of the abdomen.

At the fifth moult the insects become wingless adults, much like tne immature bugs in appearance. Adults may live for several months without food and probably up to a year or longer with a limited food supply. Unfed bugs in the first instar are credited by some with an even longer life. Discrepancies in the literature on the span of life suggest incomplete knowledge of the subject.

For food, the blood of man is preferred, but the insect can subsist on that of many other warm-blooded animals. Rats and mice are known hosts and are believed to provide the main or sole source of blood to bugs living for long periods in houses uninhabited by humans during this time.

Both young and adult bed bugs normally feed at night by seeking out their host and piercing the skin with their sucking proboscides. Like other true bugs, they have no biting or chewing mouthparts, and can suck their food only in fluid form. Bed bugs attack exposed parts of the body and are not known to feed through blankets or clothing. After feeding, they leave the host and seek a hiding place, often returning to the place they have recently left. Where

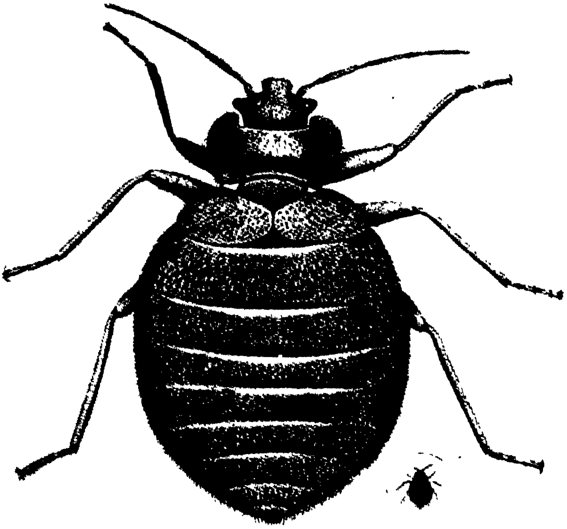


Fig. 1. The Common Bed Bug (*Cimex lectularius*, L.) (after McKenny-Hughes).

conditions allow, they prefer crawling in an upward direction to secret themselves. The tendency to crawl upwards frequently results in a hiding place being found under the cornice or even above the ceiling, where the bugs are protected from the effect of control measures carried out in the room below, and whence they may later sally forth. This habit may render control measures to some extent ineffective.

Bed bugs are mildly gregarious while resting. The fact that they gather together because they hide in cracks and crevices does not necessarily indicate that they are gregarious. But when they rest in a very slight depression on a wall, possibly within an inch or two of a suitable hiding place, as the writer has frequently seen them rest, they cluster closely together, forming a "nest." Such nests can easily be identified, even after the bugs have left, by the disfiguring excremental spots left on the wall. These nests are occupied by both young and adults, and eggs are often present.

Life Cycle.

The life cycle of different generations throughout the year have not been studied in Rhodesia. However, about a dozen specimens of *C. lectularius* were reared under rather artificial conditions in Salisbury during January, February and March, 1937, and the result is summarised in Table I. The bugs were kept individually in small cork-stoppered glass vials, the humidity probably being somewhat high and the temperature being that of the laboratory (Table II.).

TABLE I.

Life Cycle of *C. lactularius* in Salisbury, Summer, 1937.

Stage.	Range.	Average.
Egg	6—9 days.	8 days.
1st Instar	5—11 days.	7 days.
2nd Instar	6—14 days.	10 days.
3rd Instar	6—19 days.	13 days.
4th Instar	7—20 days.	14 days.
5th Instar	12—23 days.	18 days.
Egg to adult	8—11 weeks.	10 weeks.

TABLE II.

Maximum and Minimum F° Temperatures in Laboratory, Salisbury, 8th January to 31st March, 1937.

Period.	Maximum Temperatures. Mean.	Maximum Temperatures. Range.	Minimum Temperatures. Mean.	Minimum Temperatures. Range.
8-31 January......	78.6	72-82	71.6	68-74
1-28 February	76.3	74-80	70.2	60-74
1-31 March	76.5	70-84	67.8	60-73
8th Jan.-31st March......	77.05	70-84	69.76	60-74

Every few days each bug was given the opportunity, for about five or ten minutes during the day-time, to feed on the writer's arm or hand. This was done by extracting the cork stopper from the vial and placing the mouth of the inverted vial in contact with the skin. Those bugs that did not feed almost at once were released, one at a time, and allowed to crawl about the arm for the time mentioned. Up to twenty-one opportunities to feed were given each immature bug that reached the adult stage.

In Table III. data are given on the periods between feeding and on the number of feeds taken by the same insects referred to in Table I. Of two specimens in the 3rd instar, omitted from Tables I. and III. as not being representative, one refused feed for forty days, then fed and subsequently moulted, and the other refused for fifty-five days, when it died. A few adults, kept unfed in corked glass vials after the final moult, lived for 5½ to 7 autumn and winter months.

TABLE III.

Feeds taken by Immature *C. lectularius* in Salisbury, Summer, 1939.

Average interval between feeds	9½ days.
Shortest interval between feeds	2 days.
Longest interval between feeds	17 days.
Average number of feeds	5*
Smallest number of feeds	4
Largest number of feeds	7

*In one case only. Possibly an error; in every instar the bug is stated to require at least one meal.

It is probable that under normal conditions the bugs would feed more often and at shorter intervals than indicated in Table III., and that the instars would follow in quicker succession than recorded in Table I.

Medical Importance.

In Roman times, and even up to the end of the 19th century, bed bugs have had medicinal value attributed to them. The Romans used a decoction of bed bugs for internal use against snake-bite. The preparation of tincture of Cimex for the cure of malaria has been described in medical tomes used during our own life time. Other uses have been described.

From the present-day medical point of view, bed bugs are regarded with suspicion because of their potentiality of spreading human disease. Blood-sucking insects are, in general, notorious for the disease-transmitting role which they play. Although bed bugs are not known to transmit human disease normally, pathogenic organisms in diseased blood fed experimentally to them have survived for several weeks in these insects, and have multiplied. Transmission of disease from these bugs by one means or another have in some cases been accomplished experimentally, but sufficient evidence to inculpate bed bugs as a serious or common vector of human diseases has not been obtained.

The bite of the bed bug is very irritating to some people and not at all to others. The writer provided over eighty meals for captive bed bugs of various ages over a three-month period and did not at any time feel a bite or see the effects of one; nor did he feel the bugs crawling over his arm or hand.

SECTION II. CONTROL OF BED BUGS.

Various means of keeping bed bugs under control are in use. There are objections to all of them.

They can be classified into two groups of methods that may be termed *absolute* methods and *persistent* methods. Absolute methods aim at eradication in one operation, or perhaps two. They do not provide against re-infestation and subsequent natural increase until such time as the pests are again apparent. Absolute methods include fumigation by means of poison gas, and the raising of the general temperature to a degree that the insects cannot withstand. Persistent methods, on the other hand, gradually reduce the infestation to a minimum or to the point of eradication, and hold it there. Their proper continuance takes care of natural increase and re-infestation, and, therefore, the bugs do not again become troublesome. Persistent methods include cleanliness and the persistent use of contact sprays, blow lamps, etc.

The most satisfactory control is obtained by following a programme that include both groups. An absolute method is applied first and eradicates, or nearly eradicates, the bed bug population, giving immediate relief. This is followed by one or more of the persistent methods that keep the pest at a desirable level of hygienic control for as long as they are carried out. Suitably applied household cleanliness is often sufficient to maintain this happy state of affairs.

The complete assurance of entire freedom at all times without unjustifiable inconvenience is at present a practical impossibility, but the degree of control that can be and usually is obtained approximates comfortably to this ideal.

Whether absolute or persistent methods are used, but more particularly with persistent methods, the best control is obtained where there are least hiding places for the bugs. Brick walls that are plastered or well "bagged" with cement wash are better than naked brick walls. Cement ceilings are better than wooden or sheet steel ceilings with or without cornices. Cement or hardwood floors are better than softwood floors with or without skirting boards. Similar principles, involving the absence of crevices, hold with fittings and furniture.

Absolute Methods.

Absolute methods of bed bug control are applied for the treatment of severe infestations, for immediate relief from minor infestations, for the treatment of previously occupied houses, or for the treatment of newly purchased second-hand furniture or stored furniture before it is brought into a house.

FUMIGATION.

Fumigation is a standard method of bed bug control and consists of sealing the infested room or house, releasing therein a quantity of gas lethal to the insects, and, after a suitable time, ventilating.

The gas most commonly used because of its comparatively low price and effective action is hydrocyanic acid gas. This gas will not be discussed at length here, as detailed directions for its use, including precautions and information on the sealing and ventilation of rooms, were given by the writer in the March and April numbers of the *Rhodesia Agricultural Journal* (Mossop, 1939), and reprints of his article are available as Bulletin No. 1105.

A serious objection to the use of hydrocyanic acid gas by all and sundry is its extremely poisonous nature. In large towns the services of a professional fumigator familiar with the dangers and use of hydrocyanic acid gas can usually be hired. In smaller towns there is often some one to be found who has at least a little knowledge of the subject and sufficient intelligence to carry out the work with reasonable safety if he be given a copy of the above Bulletin to study. At present there are no local municipal regulations restricting the use of this gas to licensed fumigators. In spite of its dangerous nature, it has largely replaced sulphur dioxide for bed bug fumigation.

Sulphur dioxide, produced by burning sulphur or released from cylinders of the gas, has been in use for many years. There is still, however, considerable discrepancy among writers regarding the amount to use. Most of them nowadays mention the discrepancy and give their own ideas on the subject.

It is convincingly stated by Schlupp (1922) that, with an exposure of 24 hours, the burning of four pounds of sulphur per 1,000 cubic feet of space for each application is sufficient for fairly good results if two applications are made with 2½ to 5 weeks intervening. The second application is chiefly to kill young bugs hatched from eggs that have survived the first, and an interval of two weeks should normally suffice. In Salisbury in a fumigating chamber in good condition, exposed eggs have been killed at this concentration-time combination. A dosage of not less than seven pounds (length of exposure not stated) is suggested by McKenny-Hughes (1937) for killing bed bugs and their eggs, though he states that eggs are not always killed. He estimates that under ideal conditions in a house, one application may be found to be effective in, say, five out of every six houses. Ideal conditions would include fairly high temperature, perfect sealing, and the absence of absorbent materials and of small crevices.

Discrepancies probably arise from differences in the type of house being treated, an important factor being the nature and depth of crevices in which eggs may be laid or in which young bugs may hide. In any case, the use of sulphur dioxide is not entirely satisfactory. Its corrosive effects on some metals, and its bleaching and destructive effects on certain fabrics are distinct drawbacks.

A suitable technique for burning sulphur has been described by Schlupp (1922), and those who wish to use this fumigant rather than the more dangerous but more effective ones should write to the Chief Entomologist for information.

Fumigants that are less poisonous to humans are being developed overseas, and some of them are in commercial use.

A serious obstacle to their local use is the cost of importation, as they are transported under pressure in heavy cylinders. The demand would be insufficient to justify local production.

Of later developments, one gas stated to be very promising is "washed heavy naphtha," which is unfortunately inflammable. Another is methyl bromide, a fire extinguishing fumigant apparently of great potentialities. In the United States of America, Mackie (1938) has recorded its successful use against bed bugs at the rate of one pound per 1,000 cubic feet for sixteen hours. Methyl bromide can be conveniently transported in 1 lb. tins costing about three shillings a pound (at par) in case lots in California. If it can be landed in Rhodesia and sold at a reasonable price it should prove to be a popular fumigant for amateur work. Its use is attended with some slight danger, but now that these dangers are known, it can be applied with safety by any normally intelligent person.

GENERALLY APPLIED HEAT.

Raising the temperature of a room, house, or other structure to a point lethal to bugs is an excellent and usually safe absolute method of control where it can be applied. The time of exposure will depend on the time taken to raise the temperature in deep crevices. This varies with the weather conditions, the structure of the room, and the nature of the furniture, including the thickness of mattresses and upholstery. In native servants' quarters with unpointed, naked brick walls, crevices in the walls may be so deep as to render control by this method impracticable.

In general, it may be said that maintaining the temperature at about 125° F. for several hours is satisfactory. Where penetration is slow, twenty-four hours may be necessary. A hot day should be selected for the operation, and ventilators and cracks under doors, etc., should be sealed from the outside. If braziers are used, every precaution should be taken to prevent fire and to ventilate the room thoroughly afterwards.

Persistent Methods.

Persistent methods are essentially for use by the occupants of the room or house, or by their servants. They are usually applied in the combat of minor infestations, or as a routine precaution. Given time, they can be made to reduce a major infestation to more controllable proportions.

Many contact sprays for killing bed bugs and other household insects are on the market. Some of their manufacturers may make rather extravagant claims for their products, and, by omission of detailed directions, unfortunately convey the impression that only one application is necessary.

VOLATILE SPRAYS.

The average household spray is made up from formulae which include principally light, volatile, mineral oils such as some of the paraffin oils, and pyrethrum. Different grades of oil may be used, and other volatile liquids may be added, including liquids to reduce fire risk. Derris, or similar vegetable poisons acting on the nerves of insects, may be used in addition to the pyrethrum, and some formulae include certain organic thiocyanates and other compounds. The larger manufacturers of these sprays state on the containers that their contents do not stain or injure delicate fabrics, and they are in a position to carry out well-planned tests in this direction before making such statements.

Unless the volatile household spray in use is specifically stated to be free of fire risk, due precautions should be observed.

The sprays are applied by means of inexpensive atomisers to all cracks and crevices in furniture, floors, walls, cupboards, picture rails, and other places where the bugs may be hiding. Bugs with which the spray comes into contact are killed, and the vapour is also toxic if sufficiently concentrated.

Enough spray should be used to treat all hiding places of the bugs. As this factor varies with the type and amount of furniture and fittings, and with the type of room, no hard-and-fast rule can be made. For the past year the writer has been using with apparent success an arbitrary two fluid ounces per week in a plastered room with cement floor and roof. This room is of about 10 x 10 x 10 feet and is occupied by three natives and their belongings.

Control by atomising volatile oil sprays has the advantage of reducing the number of mosquitoes, clothes moths, fish moths, flies and cockroaches, in addition to having the required effect on bed bugs. Cockroaches, of course, are less likely to be of much importance in Europeans' rooms normally treated for bed bugs, being found chiefly in the kitchen, scullery, pantry, bathroom and dining room. Control of bed bugs in European houses is usually confined to bedrooms, though in severe cases bugs may be found in the other rooms. Cockroaches, however, are commonly an integral part of the insect fauna of native quarters.

Application of sprays of this kind should be made weekly at least for as long as any bugs are known or suspected to be present. The most important time of the year is from September to April or May. Applications must be thorough and comprehensive. Every possible hiding place must be sprayed. Cupboards should be open and drawers pulled out of furniture; chairs should be turned upside down and beds preferably taken apart. The operator is then enabled to spray inside the furniture as well as outside. Beds and mattresses should receive especial attention, as should the adjacent skirting boards and picture rails.

When a severe infestation has been brought under control, these vigorous methods should theoretically be continued. In practice, however, it is usual to abate the vigour of attack, whilst continuing to use the atomisers. Occasional spraying of the bed and mattresses and vicinity will often prevent the pest from becoming evident, but as soon as a single bug is seen, the battle should be intensified.

Volatile sprays are suitable for use in houses, hotels, boarding houses, native rooms, public waiting rooms, restaurants, and so forth.

EXPERIMENT WITH HEAVIER, NON-VOLATILE SPRAY.

A different type of spray which is similar in some respects to the foregoing is a white oil-pyrethrum spray developed during the last few years by Potter (1935) for combating insects in warehouses and factories, and primarily for the control of pests of dried fruit. This spray is a mixture of a non-volatile, comparatively heavy oil with a higher percentage of pyrethrum than is believed to be normally included in household sprays. The spray needs to be atomised with fairly high pressure, the cheap hand atomiser not being satisfactory for this purpose.

It is different from the volatile sprays already discussed in that it is far less volatile and that its action does not depend so much on immediate contact. When it is atomised properly with high pressure into the atmosphere of a room, a cloud consisting of minute particles will hang for considerable periods before completely settling. In settling during this time, it coats all objects with a very fine film, and sufficient contact with this film is apparently effected by the bugs when they crawl over it. Exposed insects will, of course, be coated with the spray and succumb to its effects more rapidly.

The writer used a spray of this nature, known as "Pyremist L.," in a native's sleeping quarters of plastered brick with concrete roof and floor. The room measures 1,000 cubic feet, and one fluid ounce of spray was used for each application. This was atomised by means of a foot-operated paint sprayer at a pressure of 25 to 30 lbs. per square inch. Clouds were formed in the room, which was kept closed for an hour or two after each application before being aired. No undue attention was paid to cracks and crevices, as the object of the test was to discover the effect of the formation of evenly distributed clouds of spray. Clouds were formed in the body of the room, under the bed, and in similar spaces. To begin with, the spray was thus applied once a fortnight from October, 1938, until the end of April, 1939.

The initial bed bug infestation in October was heavy. According to the single occupant, an intelligent native employed in the Agricultural Department, the first application gave immediate relief. The infestation was soon brought under control, the occupant stating that there were no more bugs in his room. This may be taken to mean that at the most there were very few, and that none could be found. The position continued to be very satisfactory, while neighbouring, untreated rooms were heavily infested.

At the beginning of May, therefore, it was decided to reduce treatments to one every month, at least for the winter, and to watch for results in the spring when the bug population normally increases rapidly. Complaints would hardly be expected during the winter months, even in an untreated room, provided a clean start were made. No complaint was made by the occupant of this room during the winter. In untreated rooms in September and October, however, complaints would be expected and were duly made, but in the treated room bugs still appeared to be absent. At the time of final writing (January, 1940) the position is entirely satisfactory, no bugs having been found during the winter or summer months. No damage to the comparatively cheap fabrics which contributed to the furnishings of the room was reported.

It should be pointed out that the occupant of this room, like many other natives of his type, had a large sheet or two of decoratively coloured paper pinned to the walls, and curtains surrounded his bed. He also used a mosquito net, which is usually an easy and likely place to find a bug if an infestation is present. His furniture was made of converted packing cases, and the bed was roughly constructed of unplaned packing case planks nailed together. Such furniture affords ideal hiding places for bed bugs. Numerous suitcases and odds and ends completed the contents of his room. Under these circumstances the control of bed bugs without resorting to fumigation is usually very unsatisfactory.

"Pyremist L.," used in the above test and stated to be made according to details published by Potter (1935) is, briefly, a highly refined white oil resembling medicinal paraffin and similar in specifications to "Shell Oil 24210," containing 0.813% total pyrethrins. Potter used this concentration of pyrethrins for the *direct* spraying of stored products insects or their hiding places, but used double the concentration for *cloud-spraying* in warehouses. He is now believed to be modifying the spray for bed bug control (Potter, 1938) and his initial experiments suggest that for this purpose an organic thiocyanate will be superior to pyrethrum. This is in keeping with the views of other workers who have included thiocyanates in the more volatile oil sprays.

In the meantime a spray of the concentration mentioned above when atomised at high pressure is satisfactory, though quicker results might be obtained by increasing the pyrethrum content. The pump costs five or six pounds in England, and if it is to be used for several rooms or for other purposes such as paint spraying and garden spraying, the expense could be justified.

In discussing possible ill-effects on operators *constantly* using a spray of this nature, Potter (1935) states that a very small proportion of operators may be susceptible to slight skin injury or uncomfortable effects of inhalation. In the rare cases of this kind a protective coating of cold cream on exposed parts of the body before operation and a wash in alkaline water afterwards proved sufficient to prevent the first, and a mask of cotton wool worn over the nose and mouth prevented the second.

The non-volatile atomising method is at present useful for native rooms and dormitories, public waiting rooms, etc. It will probably be found suitable for household use when more is known of its staining and oiling effect after constant use on furnishings and fabrics. (It is known to be harmless and tasteless on dried fruit and other food products.)

OTHER LIQUIDS.

There are other liquids on the market stated by the makers to be most effective for bed bug control but their composition is not known to the writer; nor has he completed satisfactory trials with them.

Cleanliness.

Household cleanliness, including the use of oil or wax polishes, and soap combined with the mechanical effects of the scrubbing brush, help to prevent excessive increase in bed bug populations. The presence of fluff indicates that the places where it is allowed to accumulate do not receive regular attention, and fluff can therefore be a suitable hiding place for bugs.

Personal cleanliness as normally observed by Europeans in this country is also important. Although a bug usually leaves its host after it has fed, it may lodge in his clothing. Washing of the clothes will usually result in the bug's removal from the house, whether or not it be killed.

Occasional stories of bugs being secreted in clothing or household linen returned from the laundry are not without foundation. The writer has seen two instances of this in Salisbury, but in both cases the insects were very inactive and easily captured and despatched. An excess of soap or the heat of the flat-iron may have been responsible for their poor state of health, and they probably would not have survived in any case. Nevertheless it is possible that healthy specimens have been introduced in this way, and, on account of their activity, escaped notice; but if this is so, they have not, in the writer's experience, led to a serious infestation. Parcels of laundry ready for delivery, left overnight in the laundryman's house or near incoming laundry may, under certain circumstances, offer suitable transport facilities for bed bugs.

Cleanliness is only a supplementary aid to bed bug control, and under practical conditions will not in itself control a serious infestation. Its observance, however, is believed to be largely responsible for the satisfactory freedom from the pest enjoyed in most of our homes. But the presence of bed bugs in a house does not connote lack of cleanliness and is no more of a disgrace, and less of a menace, than the presence of flies or mosquitoes, except where no serious effort is made to control them.

Local Application of Heat.

The frequent use of blow lamps in native servants' quarters and native compounds with brick-walled rooms often helps considerably to keep down bed bug infestations. It is not necessary that the flame be applied directly to the bug provided that the insect is heated sufficiently to be killed. Bugs hiding in shallow crevices in walls, iron beds, etc., can therefore be killed with comparative ease, though many in more protected hiding places escape. Much depends on the nature of the construction and of the fittings and furniture. Necessary precautions should, of course, be taken to prevent the outbreak of fire.

A barrier and shelter to confine the bugs to the lower parts of the room and to give them a suitable hiding place where they can more conveniently be killed is described in the next section.

(To be concluded.)

Larger Calf Crops will Increase Your Profits.

By C. A. Murray, Senior Animal Husbandry Officer in Charge, Government Experiment Station, Matopos.

Figures published by the Government Statistician give the average calving percentage in European-owned herds of cattle in the Colony at 47, 47, 46, 48 and 51 in 1933, 1934, 1935, 1936 and 1937 respectively. If these figures are substantially correct, and I believe they are, they certainly reveal a very serious state of affairs, *viz.*, that for every calf produced annually two cows have to be run or, putting it differently, that every cow only calves once in two years.

It is surprising to find how little serious thought is given to this question by the average farmer and rancher and it is not uncommon to be told by many that their average calving percentage is about 75% when it is never in the vicinity of this figure.

Before going any further let me first stress the vital economic importance of regularly getting large calf crops.

There is a direct relation between the cost of production of cattle and the percentage calf crop. In the U.S.A., where extensive economic investigations were carried out on a large number of ranches, the following data were obtained:—

Percentage Calf Crop.	Net Cost of Production per Calf.
40—50	£9 8/-
50—60	£7 8/-
60—70	£7 2/-
70—80	£5 6/-
80—90	£5 1/-
90—100	£4 4/-

These figures are certainly very illuminating and from our standpoint are of value in that they show that as the calving percentage increases the cost of production of cattle decreases. In fact, under conditions in the U.S.A. it costs about twice as much to produce a calf when the calving percentage is 40 to 50 per cent. as when it is over 80 per cent. On the basis of these figures we should, in this country, be able to reduce production costs by from 30 to 40 per cent. if our farmers and ranchers could raise the calving percentage of their cattle to between 70 and 80 per cent.

Many farmers do not yet seem to be at all seriously concerned when they obtain only a small calf crop. Actually they suffer enormous loss. If, for instance, a farmer gets 100 calves from 200 cows (50 per cent.) as against a possible 140 (70 per cent.) it means that he will have for sale in four years time approximately 85 head in the former case (after allowing for losses) instead of approximately 120 in the latter. In other words, his annual calving percentage is 50 per cent., his annual loss on the sale of four-year-old cattle is a shortfall of 35 head, and these at £6 each would give the very useful sum of £210.

It seems very seldom, if ever, that a farmer looks at it in this way and makes a simple calculation to show what he is losing. It is only when he sees an actual death from disease or poverty that he appears to consider he has suffered a monetary loss.

RESPONSIBLE FACTORS.

The following are, I believe, the main causes of our small calf crops:—

(1) The plane of nutrition of the animals—cows and bulls.
(2) The time of the year the cattle are bred.
(3) The system of running the bulls and cows during the breeding season.
(4) The proportion of bulls to cows.
(5) An inherited tendency of some females to be "shy" breeders.
(6) The lack of selection and culling in the breeding herd.
(7) Contagious abortion.

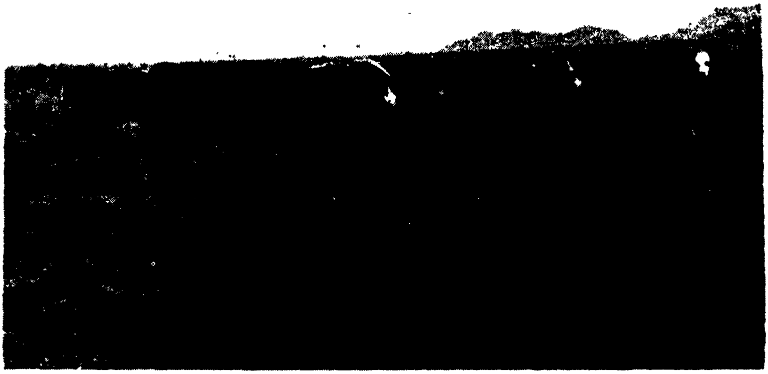
It is worth while discussing these different causes in some detail.

(1) **The plane of nutrition of the animals: Thin Cows.**—It is well known that cows in poor condition seldom come into season. If they do and are served they seldom conceive. There are many factors in practical management which effect the plane of nutrition.

During the few best summer months our pastures are usually very good. During the winter, however, the cattle, especially cows with calves, lose condition very considerably and often get into such poor condition that they will not take the bull the following season. This is one important cause of the small calf crops obtained on many farms and ranches. In the same way small calf crops are usually associated with an adverse previous season. In many cases over-stocking is responsible for the poor condition of the cows. In other cases the calves are allowed to run with the cows until the latter calve again, and hence the cows never get a chance to recover from their previous calving and lactation. Too often, too, good grazing is not saved for late winter use for thin cows or to prevent others from getting too thin, neither is provision of hay, stover, silage, etc., made for feeding to such animals. Lack of fenced paddocks necessitates the cattle being kraaled, which in turn prevents the cows from grazing during the time of the day when they usually graze most, *i.e.*, in the early mornings and late evenings. Where kraaling is practical cattle are too often turned out too late in the morning and brought in again too early in the afternoon. Lack of water often makes it necessary for cattle to walk long distances for a drink and usually, to make matters worse, the land near such watering places is hopelessly over-grazed.

All these factors lower the plane of nutrition, and hence the condition of the animals, with the result that cows do not take the bull. It is certainly the duty of each farmer and rancher to study the conditions on his farm and do whatever is economically possible to keep his cows, especially those with calves, in reasonably good condition. He will find that his calf crops will go up automatically as a result of the improvement in the condition of the female stock.

Thin Bulls.—All the trouble is, however, not with the cows. Too often one sees bulls in such low condition that they can scarcely walk, dragging themselves along with a mob of cows.



Bulls should be kept in good condition for best results.

Such bulls, even if they occasionally serve a cow, will not put her in calf. This is due to the fact that the sperms of such animals become sluggish and often quite inactive and so cannot fertilise the ova in the cow.

It is advisable, therefore, that bulls should be in good hard condition when put to the cows and that they should, whenever possible, be kept in such condition. In the majority of cases it will pay the breeder well to give the bulls a small feed of concentrates in the paddock every day or every other day. This system is practised very extensively and successfully in the United States. In other cases a few of the bulls are brought home every fortnight and fed up for a week or two and then put into the herds again. These practices have much to commend them.

The practice of running bulls with cows throughout the year is generally not a good one. It is usually done for the purpose of increasing the calf crops. Actually it often has the opposite effect. This is due to the fact that where the bulls are run with the cows for three to four months only, and then taken out, they have an opportunity to recover and build up their condition and so start the next breeding season in first class shape, whereas when they are left with the cows all the time they usually become very run down in condition.

In the American investigations to which I have referred it was found that "the ranches on which the bulls were kept from the cow herd had a 77 per cent. average calf crop for three years, and on the ranches where the bulls were not removed from the cow herd the average calf crop was only 64 per cent. for the same period. The condition of the bulls was directly responsible for a 13 per cent. increase in the number of calves dropped."

(2) **The time of the year the cattle are bred.**—If the bulls are run with the cows throughout the year the great majority of cows will calve in August and September or October and November, depending on the normal rainfall for the area. From this it is obvious that the majority of cows in these areas come into season either during November and December or during January and February.

To get the best results the bulls should, therefore, run with the cows during these seasons. Unfortunately, however, calving from September to November has of recent years become dangerous, due to the succession of bad seasons. Farmers have, therefore, been compelled to keep the bulls out and breed the cows to calve in December and January after the commencement of the rains. This difficulty can, however, be overcome and cows can be bred during the optimum period if some supplementary feed in the form of hay, silage, stover, etc., is provided for tiding the cows and weaners through the few worst months—September to November.

(3) **The system of running the bulls and cows during the breeding season.**—On paddocked farms and ranches the bulls are usually put with the cows in paddocks which vary in size from 500 to 5,000 acres. The result is that the cows are scattered over an enormous area and as the effective heat periods lasts only a short while they are often not served in time, if at all. Another disadvantage of such large breeding paddocks is that the bulls often walk many miles, following the same cow, and consequently become so fatigued that they do very little work. The remedy seems to be to have smaller breeding paddocks or to herd the cows in the present paddocks during the two or three breeding months and sleep them at night in small 30 to 50 acre paddocks which can be erected at convenient places in the larger paddocks.

This method is followed very successfully in certain overseas countries.

(4) **The proportion of bulls to cows.**—In herds where there is a shortage of bulls large calf crops cannot be expected. Generally, under ranching conditions, 4 per cent. to 5 per cent. of bulls should be sufficient, provided that they are kept in reasonably good condition and they are not left with the cows in too large paddocks. On farms 2 per cent. to 3 per cent. of bulls will give satisfactory results provided the bulls are well fed and the service paddocks are small. But under conditions where the cows run in large paddocks and get scattered the use of 5 per cent. to 6 per cent. of bulls is fully justified. In the worst parts of Brazil, for instance, the use of 6 per cent. to 8 per cent. of bulls has been found necessary.

(5) **The inherited tendency of some females to be "shy" breeders.**—It is well known that certain forms of partial or

complete sterility are inherited. Often a cow will be found to breed only once in three years. Such cows should be culled from the herd immediately they are noticed. If kept and bred from, their progeny will have the same tendency and unless care is taken such infrequent breeders will be increased in the herd. This will especially happen if bulls from such cows are used. In the selection of bulls care should, therefore, also be taken to see that they are from regularly breeding cows.

(6) **The lack of selection and culling.**—Reference has already been made to this in discussing "shy" breeders. It cannot, however, be emphasised too strongly that all females that do not calve for two years in succession should be got rid of. In the majority of herds I have visited in this Colony I found cows that have not calved for three to five years. These "boarders" increase the cost of production, and when they do calve tend to produce similar "boarders." It is, therefore, a sound and good policy for farmers and ranchers to make it a rule to cull all females that skip two years in succession. Such cows can very easily be identified by means of a small mark in the ear or brand on the cheek. All unthrifty females and those which never go through the winter in fair condition should also be culled regularly. The majority of these will usually be found to calve only every other year.

(7) **Contagious abortion.**—The wide extent to which contagious abortion is present in our herds is realised by very few. In many cases this disease is not only responsible for lower calf crops through abortion but the after-effects of it often cause partial or complete sterility. The Veterinary Department should be consulted wherever the disease is suspected.

Present knowledge of the many different factors affecting the size of our calf crops is rather limited. Investigations are at present in progress at the Matopos to throw more light on this problem. It is hoped, however, that this short note will stimulate interest and thought on this very important problem. Low calving percentages have certainly caused heavier losses to cattle farmers than droughts, over-stocking and disease put together.

Rhodesia Weather Bureau.

DECEMBER, 1939.

PRECIPITATION.

Station	Inches.	Normal.	No. of days.
Beitbridge	1.81	2.27	5
Bindura	10.09	7.05	22
Bulawayo	3.64	5.07	12
Chipinga	6.16	7.92	15
Enkeldoorn	6.23	6.58	18
Fort Victoria	4.64	5.51	9
Gwaai Siding	3.81	5.23	15
Gwanda	1.34	4.24	8
Gwelo	4.97	5.83	15
Hartley	11.26	6.68	23
Inyanga	15.51	7.49	23
Marandellas	11.78	7.31	23
Miami	17.10	7.15	19
Mount Darwin	10.10	6.51	22
Mount Nuza	13.37	15.55	26
Mtoko	9.81	6.81	23
New Year's Gift	3.76	5.33	12
Nuanetsi	0.65	2.90	5
Plumtree	3.33	5.46	11
Que Que	5.95	6.17	17
Rusape	13.30	7.04	20
Salisbury	11.81	5.91	24
Shabani	2.00	4.65	8
Sinoia	11.61	6.79	20
Sipolilo	16.57	7.11	21
Stapleford	13.56	12.32	26
Umtali	7.82	5.46	20

Station.	Inches.	Normal.	No. of days.
Victoria Falls	7.97	6.01	18
Wankie	7.25	5.49	13
Broken Hill	12.14	—	23
Chinsali	9.47	—	12
Choma	13.67	—	25
Fort Jameson	11.81	—	23
Fort Roseberry	7.12	—	17
Kapiri Mposhi	5.27	—	19
Kasama	8.28	—	20
Kasempa	13.29	—	23
Luangwa	9.20	—	19
Livingstone	7.45	—	18
Lundazi	8.58	—	19
Lusaka	9.84	—	21
Mankoya	10.69	—	16
Mazabuka	8.25	—	14
Mkushi	11.63	—	20
Mongu	14.95	—	24
Mpika	6.59	—	21
Mporokoso	1.53	—	19
Mufulira	10.78	—	20
Namwala	10.59	—	16
Ndola	9.55	—	25
Petauke	12.04	—	17
Sesheke	6.06	—	17
Shiwa Ngandu	9.26	—	20
Solwezi	12.58	—	17

DECEMBER, 1939

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F.														PRESSURE MBS.			Cloud Tenths.	Sunshine hours.
		8.30 a.m.							Absolute.		No. of Days.									
		Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min.÷2.	Maximum. Date.	Minimum. Date.	Max. > 85°	Max. < 70°	Min > 65°	Min. < 40°	Mean of 24 hrs.	8.30 a.m. Station Level.	8.30 a.m 1200 gdm.	Mean of 24 hrs.		
Beitbridge	1,486	77.5	69.6	66	10.5	89.9	68.2	79.1	106:22	59:11	22	—	25	—	78.7	963.3	882.5	961.3	6.2	—
Bindura	3,700	70.2	65.3	63	6.0	79.1	63.3	71.2	87:23	57:11	1	—	2	—	—	—	—	—	7.7	—
Bulawayo	4,393	68.1	63.1	60	5.9	78.6	60.0	69.3	85:18	54:15	—	1	—	—	68.8	868.9	880.2	867.5	7.7	5.9
Chipinga...	3,685	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Enkeldoorn...	4,808	66.8	63.0	61	4.4	77.1	59.9	68.5	87:13	55:15	3	—	—	—	—	856.7	880.3	—	7.4	—
Fort Victoria	3,571	71.4	64.8	62	7.9	81.1	62.9	72.0	90:22	58: 9	8	1	9	—	70.8	894.8	880.8	893.6	6.8	—
Gwanda...	3,233	72.2	64.7	61	9.0	83.5	62.9	73.2	94:22	56:15	15	—	5	—	72.6	905.4	880.8	903.7	6.5	—
Gwelo	4,629	67.8	63.2	61	5.4	77.9	60.6	69.3	88:22	55:15	1	1	—	—	67.8	861.7	880.1	—	7.1	—
Hartley	3,879	69.2	65.1	63	5.5	78.6	62.7	70.6	87:13	56:11	1	—	1	—	69.2	884.9	880.4	—	7.7	—
Inyanga	5,503	65.9	61.6	58	4.9	72.1	57.4	64.8	78:23	60:13	—	8	—	—	63.1	—	—	—	7.4	—
Marandellas	5,453	64.8	61.1	59	4.0	72.1	58.4	65.2	81:23	53:11	—	7	—	—	63.8	—	—	—	7.8	—
Miami	4,090	67.7	64.5	63	3.9	77.4	61.9	69.7	87:22	57:11	1	1	—	—	68.2	878.0	880.0	876.6	8.6	—
Mt. Darwin...	3,179	71.0	66.7	64	5.5	80.1	64.8	72.5	87:23	59:11	4	—	9	—	—	—	—	—	7.9	—
Mount Nusa	6,668	57.8	56.6	56	1.2	64.3	53.5	58.9	75:22	46:10	—	26	—	—	57.7	801.5	880.6	—	9.1	—
Mtoko...	4,136	68.5	64.5	63	4.8	76.3	61.9	69.1	84:23	56:11	—	1	—	—	68.1	877.4	881.0	876.1	7.0	—
New Year's Gift ...	2,690	73.1	68.0	66	6.6	83.2	62.8	73.0	92:22	57: 9	10	—	3	—	—	—	—	—	—	6.1
Nuanetsi	1,547	77.0	69.7	67	9.7	89.1	65.6	77.4	105:22	57: 9	21	—	15	—	—	962.3	882.6	—	5.6	—
Que Que...	3,999	68.5	64.8	63	4.3	78.9	62.6	70.8	87:23	55:15	4	—	3	—	69.0	881.2	880.4	879.8	7.9	—
Rusape	4,648	68.1	63.2	61	5.7	75.4	61.2	68.3	83:23	57:13	—	2	—	—	66.5	—	—	—	7.4	—
Salisbury	4,831	66.7	62.6	60	4.9	75.6	60.0	67.8	83:13	53:11	—	1	—	—	66.3	855.8	880.3	854.5	8.6	4.7
Sinoia	3,795	70.3	66.5	65	4.6	79.3	63.3	71.4	85:23	57:11	—	—	4	—	—	—	—	—	7.5	—

DECEMBER, 1939 (continued)

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F.														PRESSURE MBS.			Cloud Tenths.	Sunshine hours.
		8.30 a.m.							Absolute.		No. of Days.									
		Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min.÷2.	Maximum. Date.	Minimum. Date.	Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hrs.	8.30 a.m. Station Level.	1200 gdm. 8.30 a m	Mean of 24 hrs.		
Stapleford	5,304	63.3	61.0	60	2.5	70.7	56.4	63.5	81:22	46: 9	—	13	—	—	62.4	—	—	—	8.4	—
Umtali	3,672	69.1	65.5	64	4.3	79.8	63.1	71.5	88:v.	56: 9	4	1	6	—	69.5	892.1	881.2	890.9	8.3	—
Wankie	2,569	74.1	69.6	68	6.0	89.4	68.3	78.8	97:13	64:12	24	—	28	—	—	926.0	880.1	—	7.5	—
Abercorn	5,458	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Broken Hill	3,911	69.3	65.5	63	4.7	79.8	63.3	71.6	85:13	59:11	—	—	4	—	69.4	884.1	880.3	—	8.2	—
Fort Jameson... ...	3,815	72.4	66.6	64	7.1	82.0	64.4	73.2	88: 1	59:11	4	—	7	—	71.0	887.3	881.1	886.1	6.5	—
Fort Roseberry ...	3,830	69.0	65.7	64	4.0	80.2	62.8	71.5	85:v.	58: 5	—	—	—	—	69.4	—	—	—	—	—
Kasempa...	4,500	65.1	63.9	64	1.2	79.7	60.9	70.3	84:23	57: 2	—	—	—	—	—	—	—	—	—	—
Livingstone...	3,051	71.8	68.1	67	4.7	83.6	65.2	74.4	90:13	60:13	9	—	16	—	72.6	906.7	879.2	905.0	7.9	5.3
Loangwa Bridge ...	1,330	75.9	71.8	69	5.8	89.7	71.6	80.7	99:13	67:12	26	—	31	—	78.9	—	—	—	—	—
Lundazi	3,590	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lusaka	4,193	67.9	64.5	63	4.2	78.1	62.6	70.4	83:22	59:11	—	—	—	—	—	874.6	879.9	—	8.6	—
Mankoya	3,670	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mongu	3,481	69.8	67.0	65	3.5	80.8	64.8	72.8	87: 3	62: 2	3	—	14	—	71.1	896.6	879.5	896.1	7.6	—
Mpika	4,620	67.9	64.0	62	4.5	78.7	61.5	70.1	83:23	58:14	—	1	1	—	68.4	863.1	881.4	—	8.1	—
Msoro	3,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mumbwa...	3,500	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mwinilunga...	4,450	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ndola	4,190	68.1	65.1	63	3.6	79.4	62.5	70.9	83:12	59:11	..	—	—	—	69.0	875.8	880.8	874.0	7.2	—
Chileka	2,600	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Rainfall in December, 1939, in Hundredths of an Inch. Telegraphic Reports.

Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	Normal
1	...	45	4	..	41	1	2	...	...	...	...	...	..	...	...	...	13	35	53	.	4	10	3	3	.	41	1	1	...	47	...	304	488
2	12	7	88	129	119	35	1	...	1	...	...	..	6	...	...	...	2	14	94	13	7	...	...	..	..	..	3	.	..	9	1	541	536
3	1	23	93	88	120	5	...	..	...	13	.	.	59	10	3	..	67	23	127	46	4	...	10	.	.	53	1	...	...	1	...	747	776
4	29	2	40	54	64	53	24	8	...	..	...	...	9	1	...	18	8	33	64	12	9		20	.	..	38	3	2	8	74		573	679
5	...	2	4	1	39	40	57	26	30	...	...	.	...	10	1	4	5	99	88	7	4	...	24	86	..	2	20	21	14	34	.	618	553
6	58	18	47	41	51	148	57	22	...	..		...	...	..	33	23	110	139	79	15	...	5	81	33	1	20	27	4	79	15	14	1120	718
7	47	78	124	94	106	118	109	16	..	3	...	...	13	21	15	7	42	39	38	70	35	7	15	75	47	22	25	5	29	16	14	1230	682
8	88	58	72	98	69	45	77	9	5	2	...	...	8	24	8	45	67	54	54	21	3	10	83	83	26	22	45	3	56	44	14	1193	719
9	37	47	41	89	81	8	102	44	24	...	..	...	36	50	24	68	28	24	26	16	..	12	114	282	15	38	37	4	26	45	34	1352	648
10	86	13	223	11	33	5	8	...	...	..		...	1	21	5	1	41	71	26	3	65	31	19	56	7	20	14	1	148	49	37	995	639
Mean	27	28	54	52	67	48	46	15	8	...	...	...	8	12	9	16	30	57	63	16	10	6	36	69	8	22	17	6	28	34	10	802	606

THE RHODESIA

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(Assisted by the Staff of the Agricultural Department).

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Do not Feed Sunnhemp to Horses.—The cause of death in a number of horses has recently been diagnosed as Crotalaria poisoning. Although we have a number of species of Crotalaria growing wild in the veld, a careful inspection of the farm in this case indicated that the deaths were due to feeding sunnhemp (*Crotalaria juncea*) and not to any native species. Further evidence in this direction was that although horses had been kept on the farm for many years no previous cases had occurred and last season was the first time sunnhemp had been grown on the farm and fed. This subject is dealt with at length in the "Trees and Wild Flowers" article in this Journal, and farmers are warned against feeding sunnhemp in any form to horses until further information in available.

Curing Tobacco in Air-conditioned Barns.—Bulletin 32 (1939) of the Virginia Polytechnic Institute contains an account of experiments carried out in the curing of bright-leaf tobacco in barns equipped with an air-conditioning plant.

"In the experimental application of air-conditioning to the curing and drying of tobacco, drying rate curves for each period of the curing process were obtained over a wide range of constant conditions of temperature, humidity and air velocity. Correlation of the curing curves indicated narrow limits of conditions for satisfactory curing and critical points beyond which poor quality of tobacco results. From the results obtained air-conditioning improves the process by (1) reducing the time approximately by one-half, doubling the capacity of the barn; (2) production of uniform quality tobacco, completely eliminating loss from improper curing; and (3) considerable reduction in labour and fuel requirements. Another suggested advantage is reduction of fire hazard."

Papain.—The milky juice which exudes from green fruit when the skin is lanced contains the ferment papain, which is considered to be a very valuable ingredient in medicine as a remedy for certain digestive troubles.

In the light of the unpublished investigations of H. van Elden of the Sub-tropical Horticultural Research Station, Nelspruit, and the experience of other workers, the procedure for the extraction and drying of papain may be briefly summarised as follows:—

Contrary to the general conception that non-metallic knives should be used when lancing the fruit for the extraction of the milky juice, it was found by van Elden and others, that special steel knives may be used without discolouring the latex. A steel-bladed knife has the advantage that a clean light incision can be made rapidly, without getting any of the green chlorophyll in the exuding juice.

The latex containing the papain is best obtained from full-grown, or nearly full-grown, well-developed green fruit by making 2 to 4 longitudinal incisions not more than $\frac{1}{8}$ inch deep. This operation may be repeated every 3 to 7 days. It has been found that better yields are obtained if only a few incisions are made at a time, the tapping being done over a long period until the fruit is covered with incisions approximately 1 cm. apart. The flow is most abundant in the early morning. Very young fruits give a latex that is rather weak in digestive power, while ripe fruits give very little, if any, milky juice. In South Africa we have a more or less definite period, from February to August, for tapping.

Only non-metallic containers, such as glass or porcelain dishes, should be used to collect the latex, because the juice acts on the metal and becomes discoloured. Coagulation soon begins and the mass adhering to the surface of the fruit must be carefully scraped off. Considerable time and labour would be saved if a convenient and efficient vessel could be devised which could be quickly put in place to receive the juice, permitting the operator to proceed to the next tree in the meantime.

The juice must be dried promptly after it is collected or decomposition, which destroys the value of the product, will occur. Sun-drying is practised to some extent, but it is much more satisfactory to dry the latex in a properly ventilated oven operated at 50 to 55° C.

One form of drier is about 3 feet broad, 3 feet deep, and 6 feet long. The sides and ends are made of brick, and openings are provided at both ends, one for the flue and the other to admit fuel. A foot from the top, which is open, a sheet of iron is placed, and upon this one or two inches of sand are laid to modify and distribute the heat arising from the fire beneath. The coagulated juice is spread upon brown linen stretched upon frames, which are made to fit the top of the drier. The temperature should not exceed 50 to 55° C., since great heat destroys the ferment. The dry and flaky material can be ground in a coffee-mill, preferably when the material is warm, and it should then be in the form of a light cream-coloured powder, this powder should be placed in bottles, which should be tightly sealed.

Little information is available as to yields. Amounts of papain extracted per plant vary considerably; 20 to 250 grams per tree, or from 60 to 350 lb. of dried latex powder per morgen may be produced. Coagulated latex produces 25 per cent. of its weight of dried powder. The latex is harvested through three seasons. By the fourth season the fruit is so high on the trunk that the cost of collecting the juice becomes prohibitive.

The price of the crude product is in the neighbourhood of 10s. per lb. It is a debatable point whether the production of papain in South Africa will be a paying proposition. Factors which will decide this favourably are cheap labour and high yields. The lancing operation, though it does not affect the quality of the ripe fruit, renders such fruit unsightly and hence unmarketable.

Such fruit is valuable in processing, since quality only, and not outward appearance, is the chief consideration here. It is considered that the collection of papain may become a profitable sideline in this and other countries, provided that it can be produced in conjunction with the manufacture of other by-products such as canned fruit pulp, conserve, butter, chutney, jelly, etc.

Visit of Matabeleland Farmers to Salisbury.—An event which may well prove of historic interest and which should have an important bearing on the future relations of the Rhodesia Agricultural Union and the Matabeleland Farmers' Union, was the visit on the 16th and 17th February, at the invitation of the Rhodesia Agricultural Union, of twenty-eight Matabeleland farmers (including ladies) to Mashonaland. The visitors came by car and mostly reached Salisbury on the 15th February, leaving again on the 18th. The party, led by the Hon. H. V. Humphrey-Gibbs, newly elected President of the Matabeleland Farmers' Union, consisted also of Mr. P. E. N. Nicolle, Major J. R. Perrins (Vice-Presidents), Mrs. Perrins, R. H. Greaves, C. R. Wolhuter, Major R. R. Sharp, Messrs. P. Sharp, B. Ken, P. Hensman, W. McAlister, A. Margerison, C. Beamish. Miss E. Mitchell, Miss V. Murray, Mrs. L. Murray, Mr. D. E. Williams, Mrs. Williams, Miss Williams, Mr. C. N. Brebner, Miss Brebner, Messrs. A. G. Sly, E. C. Green, C. Marshall, J. Jacobson, G. Finnie, P. E. Fuller and D. Bovell.

The party first visited, on the 16th February, Pendennis, the dairy farm of Mr. John Dennis, President of the Rhodesia Agricultural Union; from there they proceeded to the well known maize, potato and cattle fattening estate of Messrs. Newmarch and Maclean, where morning tea was taken, and returned for luncheon at the Grand Hotel. In the afternoon the new Salisbury factory of "Cattle Foods" was inspected, and later the Salisbury Agricultural Experiment Station, where the visitors were the guests of the Department of Agriculture for afternoon tea. At the luncheon, to which the Minister of Agriculture and Lands and Secretary for Agriculture and Lands were invited, suitable speeches were made by Mr. Dennis, the Minister, and the Hon. Humphrey-Gibbs.

On the second day the farms of Messrs. W. Sole, Bauhinia (Friesland cattle, pigs, horses and maize); Geo. Gray, Brawlands (maize, dairy and beef cattle); A. Millar, Estes Park (maize, pigs and pedigree and beef cattle); and Duncan Black, Selby (maize, and pedigree and beef herds of Aberdeen and Hereford cattle) were visited. Each day members of the Rhodesia Agricultural Union either accompanied their guests or met them at the various points of call.

In spite of unfavourable weather and the difficult condition of farm roads, the Matabelelanders appeared thoroughly to enjoy the tour, and to appreciate its educational aspects. Still more important, however, were the intimate contacts thus engendered, and the opportunity afforded to each party of learning something "of how the other fellow lives," the farming problems encountered, the methods adopted to cope with each and the general systems of stock and crop management which are followed.

Since the first European settlement of Rhodesia there has been a pronounced feeling, particularly on the part of Matabeleland, that their farming problems were completely different from those of Mashonaland, and that the interests of the two communities were conflicting rather than complimentary. The recent abortive attempt to bring about the fusion of the Matabeleland Farmers' Union and the Rhodesia Agricultural Union into a National Farmers' Union failed for this reason only—the fear that in a larger Union the interests of Matabeleland farmers would be subordinated to those of their more numerous Mashonaland brethren. The organised tour of Matabeleland farmers to Mashonaland, here referred to, is a first and most praiseworthy effort to dispel for all time that and similar unnecessary suspicions. We hope the tour will become an annual event of increasing popularity and will accelerate the attainment of what should undoubtedly be the goal of the farming community, namely, a strongly led and firmly welded National Farmers' Union fully representative of all branches of the industry.—H.G.M.

Look Around You Series.—The first of a new series of Nature Study books has just been published by the Rhodesia Scientific Association on Common Veld Flowers. Its title page calls it "An introduction to the beauties of the Rhodesian veld for Rhodesians and visitors alike." It is written and illustrated by Dr. J. C. F. Hopkins, Miss A. L. Bacon, B.Sc., and Miss L. M. Gyde, B.Sc., and is on sale at the Herald Store in Salisbury and the Chronicle Store in Bulawayo at 3s. or 3s. 3d. post free. This little book of 124 pages deals with 86 common Rhodesian flowers, nearly all of which are illustrated from photographs. The authors state that the book is written with a three-fold purpose, *viz.*, to assist teachers and pupils in the schools in the study of the local wild flowers; to provide some guide to the wild flowers for those who possess a natural love of the veld, and to cater for visitors by creating a wider interest in the countryside through which they pass.

The authors are to be congratulated on the manner in which they have fulfilled their purpose. They have the satisfaction of knowing that the result of their labour in preparing the book will bring pleasure to thousands of Rhodesians and visitors. Books of this kind are badly needed, and it is hoped that the Southern Rhodesia Scientific Society will find it possible to continue the series with the least possible delay. Other subjects which suggest themselves for this series are trees, ferns, butterflies, moths, dragon flies, snakes, lizards and chameleons, birds, ancient ruins, and a popular description of the geology of the country.

Concerning No. 1 of the series it is felt that a detailed review is unnecessary. It should be found in every school and every home. It is unfortunate that a few printing errors crept in, but these will undoubtedly be corrected in the next printing, which is bound to be necessary in the very near future. The transposed line near the bottom of page 106 is the most obvious error.

Trees and Wild Flowers
ON THE RHODESIAN FARM.

By CHAS. K. BRAIN, D.Sc., Director of Agriculture.

PART XII.

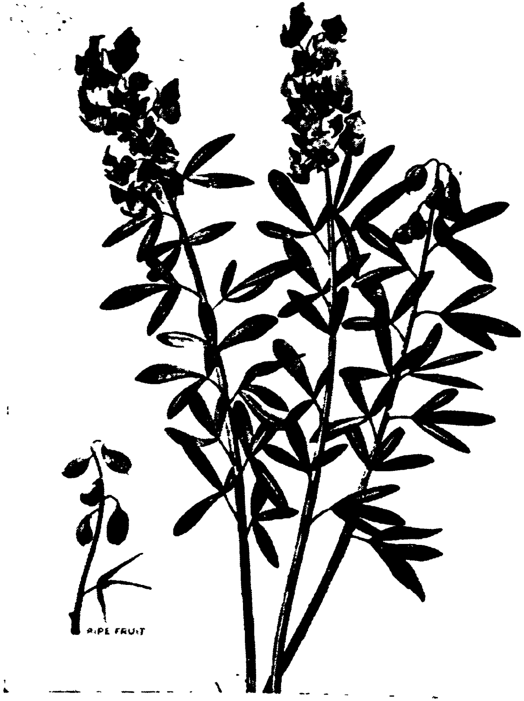
Crotalarias and Crotalaria Poisoning.—Southern Rhodesia has a very large number of legumes, but it is remarkable how few of them are eaten by stock when in the green state. When cut and dried as hay, however, many of them are relished. A striking example of this is found in the common grey-leaved *Eriosema,* which often takes possession of over-grazed commonage. This is apparently never eaten in the growing state, but when cut with hay cattle will burrow into a stack to find it. A number of the leguminosae are known to be poisonous. The seeds of the brilliant scarlet and black "lucky beans" (*Abrus precatorius* L.) contain abric acid which is a deadly poison. A few species of Cassia are poisonous to stock and a large number of legume are known fish poisons, *e.g.*, Mundulea bark, Swartzia pods, Tephrosia and Eriosema roots. The Crotalarias apparently all contain certain substances which are poisonous to a varying degree, depending upon the stage of maturity at which they are cut and the soil and climatic conditions during growth. About forty native species of Crotalaria occur in Southern Rhodesia. They are herbs or shrubs, usually erect but sometimes trailing on the ground. Most of them have trifoliate leaves, but in a few species there are 5 leaflets and a few have a single leaflet. The flowers are always conspicuous and are mostly yellow or yellow marked with purplish or brownish streaks. The upper petal (standard) is broad and flaring. The side petals (wings) are fairly large, and the boat-shaped keel which encloses the stamens and pistil is bent either from the base or the middle so that it is L-shaped or U-shaped, and ends in a sharp beak. The pod is always inflated, and although most species have long thick pods, a few have small globose pods about as big as peas. None of our native species of

Crotalaria is known to be eaten by stock in the green stage, but a large proportion of them put on new growth and flower before the rains set in so that the new growth would be likely to attract animals in search of green herbage. They are not common in the sandveld pastures, so there is not likely to be a large quantity of dry Crotalaria in the hay. On red soils the small *Crotalaria Rogersii* is often common,, and flowers in September or October. The flowers are yellowish, but densely streaked or lined with reddish brown. This has not been tested for poisonous properties.

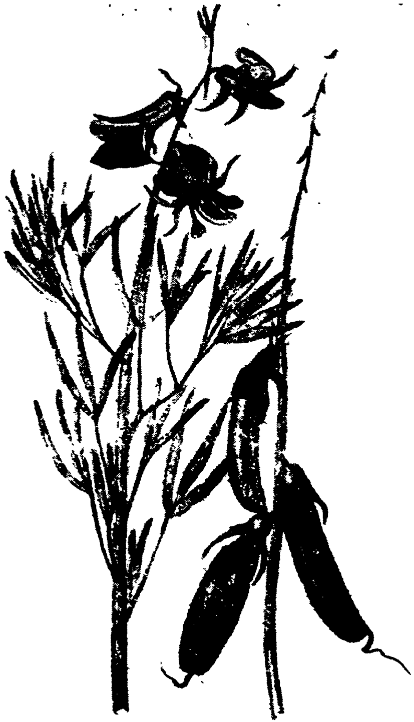
The dense succulent shrub usually 1 to 2 feet high commonly called "Wild Lucerne" by farmers has an inflated pod and looks very much like a Crotalaria. It will be noticed that the flower is quite different. The keel, instead of being boat-shaped, is very long and is coiled up in the inside of the flower like a corkscrew. This plant is *Boltisia rhodesiana* Cor., and although cattle do not appear to eat it when green it is not known to be poisonous.

Several species of Crotalaria are known to cause diseases in horses and cattle in South Africa, and it would be of great interest if farmers would report any cases which come to their notice. The best known species of Crotalaria in Southern Rhodesia is sunnhemp (*C. junsea*). The experience of the last five years or so seems to indicate that this plant, if cut in the early flowering stage and dried for hay, can be fed to cattle and sheep without any ill-effects. It grows well in most parts of the country, is relatively high in protein, and is relished by stock. The following information regarding cases of Crotalaria poisoning is given, therefore, more as a warning against feeding sunnhemp to horses until further information is available, and to encourage reports from farmers rather than to discourage the use of sunnhemp hay for feeding or fattening stock.

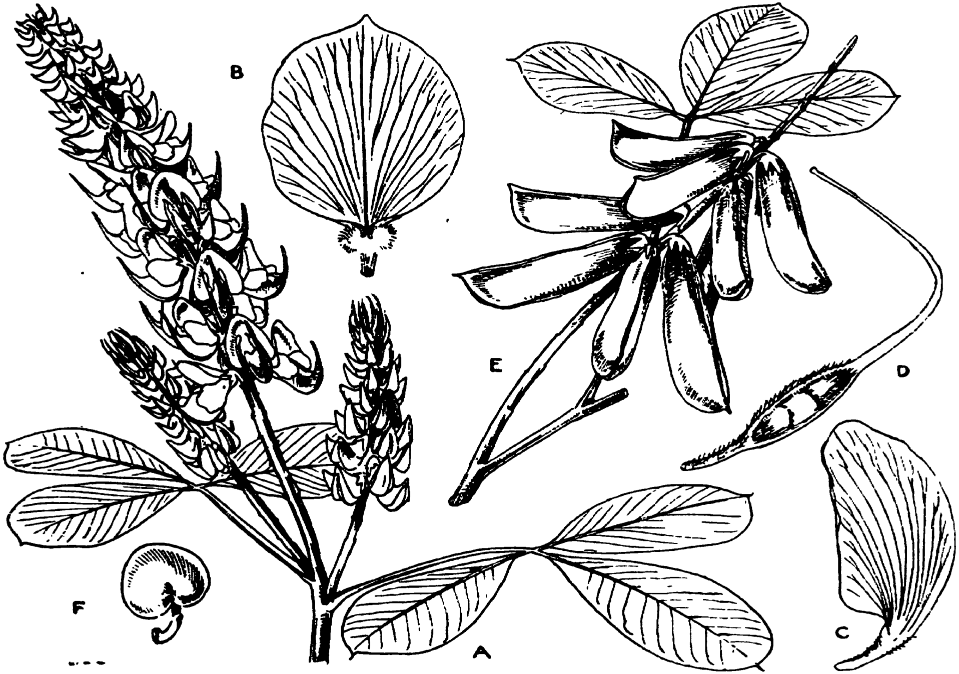
Crotalaria Poisoning.—(*a*) *Horses.*—A case has recently occurred which indicates that sunnhemp, when fed to horses, may have fatal results. Although it was not possible to prove this with certainty until confirmed by feeding tests, the circumstances were such that no other conclusion was possible. On a farm about 20 miles from Salisbury ten horses have died within the last few months. The symptoms were precisely



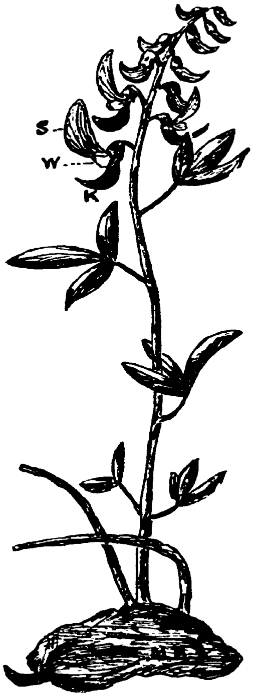
Crotalaria dura W. & E, which causes "Jaagsiekte" in horses. (After Phillips).



Crotalaria Burkeana Benth., which causes "Stiff-sickness" in cattle in South Africa. The branches are covered with long brown hairs. (After Phillips).



Crotalaria striata, a shrub common on the Eastern Border (after Hutchinson and Dalziel).



Crotalaria Rogersii. Common on red soils.
S = Standard. W = Wings.
K = Keel.

those of Crotalaria poisoning as described by Dr. Steyn, of Onderstepoort. In Natal many horses die each year from this disease, which is called "Jaagsiekte," and is characterised by fits of coughing and very deep and rapid breathing. It has been proved that the disease is caused by eating various species of Crotalaria which occur in the veld. As a rule horses do not eat the plants when grazing and most cases are due to the plants, usually *Crotalaria dura* or *Crotalaria globifera*, being cut and eaten with hay. Dr. Steyn produced "Jaagsiekte" in horses by feeding dry *Crotalaria dura* which was in the late seeding stage, and had been stored at Onderstepoort for five years. In this case the least quantity which would cause "Jaagsiekte" was about 45 lbs. dry weight, fed at an average rate of nearly 2 lbs. per day. According to Dr. Steyn: "The latest period, calculated from the time when feeding was discontinued, was 52 days, the animal succumbing to "Jaagsiekte" on the 81st day after feeding had commenced. In horses fed with the same quantity of the plant at the rate of 900 grammes daily the latent period varied from 20 to 80 days. The disease itself lasted from six to twenty-nine days. The length of the periods quoted above depends on:—

(*a*) The individual resistance of the animals concerned.

(*b*) The toxicity of the plant used in the experiment.

(*c*) The quantity of plant fed and the period in which the amount was fed."

In the case of the farm mentioned a careful inspection early in February failed to discover any *Crotalarias*, although other legumes such as *Tephrosias* and *Eriosemas* were fairly numerous. Although a number of horses had been kept on this farm for many years, none had been lost from poisoning. Last year was the first occasion on which sunnhemp (*Crotalaria juncea*) had been grown, and owing to the heavy rains last season it was not cut for hay until it was rather old. It was put through a hammer mill with oat hay and reduced to a meal which resembled lucerne meal. This was fed regularly during the late winter and continued until the supply was finished about the end of the year. Deaths began to occur about two months ago and post-mortems were conducted by the District Veterinary Officer. The symptoms observed and the post-mortem findings were exactly those of *Crotalariosis equorum* or "Jaagsiekte." A careful study of the local conditions, together with the past history, lead the writer to suspect that the feeding of sunnhemp was the cause of the deaths. The Director of Veterinary Research has undertaken to carry out feeding experiments to determine whether this conclusion is correct. In the meantime, therefore, farmers and breeders of horses are warned not to feed sunnhemp in any form to horses until further information can be given. No remedy is known for this disease, which always proves fatal to horses.

(*b*) *Cattle and Sheep.—Crotalaria Burkeana* has been proved to cause "Stiffsickness" in cattle in South Africa. According to Dr. Steyn, " Stiff-sickness " can occur in an acute, sub-acute or chronic form. "In the acute form of the attack the hoofs are sensitive to pressure and warm. The horn of unpigmented hoofs has a reddish colour. When standing the affected animals lift the feet alternately; the forelegs are placed forward and the hindlegs are put well under the abdomen. The back is arched. The gait is typical of an animal with laminitis affecting all four feet, and the animals frequently lie down. The pulse and respiration of animals in the acute stage of the attack are accelerated, and the temperature rises." This must not be confused with what is commonly called "Stiff-sickness" or "Three-day-sickness" in this country.

In the sub-acute and chronic forms of the attack the pain in the feet decreases and the gait becomes stiff rather than painful. The hoofs begin to grow out and may reach enormous lengths. The abnormal gait seen at this stage is due not to pain but to mechanical interference of the long toes. A rattling sound is heard when the animals walk, especially when they are driven fast, as a result of the elongated toes knocking on the ground and against each other. The animals loose condition, since they can rise and move about only with great difficulty. Bad cases are unable to rise, and if not attended to die of debility or starvation. The mortality depends on the way in which the affected animals are attended to. If the affected animals are well nursed there should be hardly any mortality.

Although *Crotalaria Burkeana* has not been recorded from Southern Rhodesia, there appears to be little doubt that "Stiff-sickness" in the chronic form does occur in some parts of the country. It has not been suspected that sunnhemp causes any disease in cattle, but it has been pointed out that all species of Crotalaria may produce the substance responsible for the disease in varying quantities, and may not be all equally serious. It has been found that climate and soil have a very important bearing on the amount and nature of the poisonous substances produced by the plants and that one season's crop may be much more potent than that grown in another year. It is also possible that the poisonous substances are produced most strongly when the plants are forming seed and that when cut early they are not so dangerous. In January, 1920, sunnhemp seed was sent to the Imperial Institute for analysis, as reported in the *Rhodesia Agricultural Journal* for July, 1922. The report stated: "The seeds did not contain any cyangenetic glusosides, but a substance was present which gave a reaction similar to those of alkaloids, and it might therefore be dangerous to use the seeds as a feeding stuff. The seeds of allied species of *Crotalaria, e.g., Crotalaria retusa, Crotalaria sagittalis* and *Crotalaria striata,* contain an alkaloid which is probably cytisine, a highly toxic substance." It may be mentioned that *C. striata,* a shrub 3 to 6 feet high, is common at Umtali and other parts of the Eastern Border.

In view of the possibility that the seeds contain a poisonous alkaloid, it was pointed out that careful trials would be necessary before they could be recommended for feeding to cattle. Acting on this suggestion, preliminary feeding trials were conducted at Gwebi by the Department of Agriculture. The results seem to indicate that the seed is harmless to sheep when fed in small quantities, but that it is not suitable for use in large quantities. No ill-effects were noticeable when a quarter of a pound of the crushed seed, mixed with crushed maize, was fed daily to a sheep for a fortnight, but when double this quantity was given, a sheep began to show signs of partial paralysis and general indications of poisoning, and after ten days it died. The sunnhemp seed was objectionable to the sheep, and therefore not eaten readily.

A Home-made Cow Stanchion.

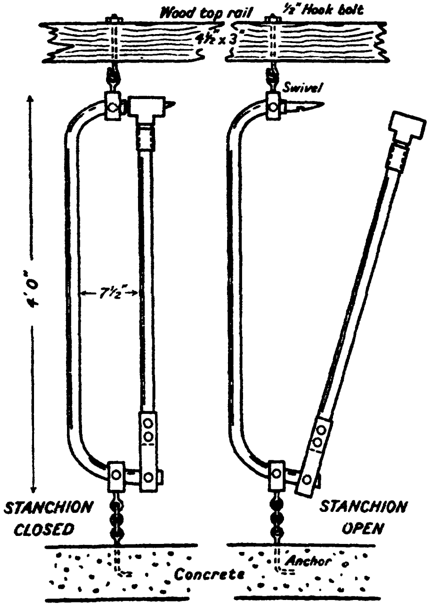
By Major R. R. Sharp, Whinburn, Redbank.

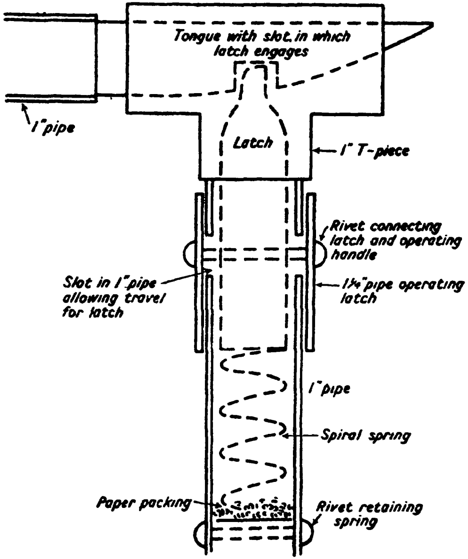
It is, I suppose, the ambition of most dairy farmers to equip their cow-byres with stanchions, but the cost of the purchased article is usually prohibitive.

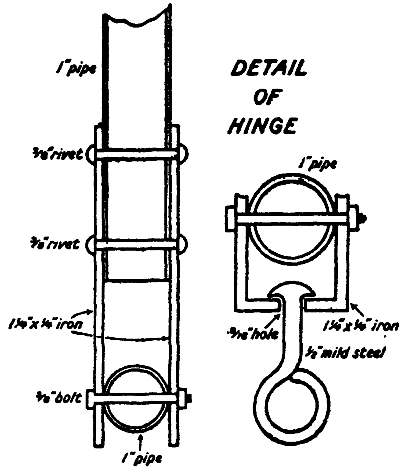
The writer faced with this problem has recently devised a home-made stanchion, which can be turned out in the farm workshop at the cost of some five or six shillings. The stanchion, which is shown in the accompanying diagram, is made chiefly of 1 inch piping. Black piping is preferable, as it is easier to bend and screw; the difficulty of cracking the bends can be overcome if desired by bends or elbows; these, however, slightly increase the cost and, of course, weaken the structure at the points where the pipe is screwed.

The stanchion consists of two pieces of inch pipe hinged at the bottom. The longer piece is bent at each end and is suspended by a swivel joint from a heavy wooden rail running the length of the byre, 4 feet 6 inches or 5 feet above the floor, and attached at the bottom by another swivel and a few links of light chain to an anchor embedded in the concrete curb forming the front of the manger.

The difficulty in bending the pipes arises from the fact that very short bends have to be made and the pipe is liable to distortion in the process. This can be obviated to some extent by filling the pipe first with sand. The bend is then made in the fork of a tree or other convenient place without heating the metal. The necessary leverage can be obtained by inserting the end of the 1 inch pipe into a length of 1¼ inch pipe. The pipe is then gradually bent, moving it an inch or so at a time in order to distribute the bend over the whole of the available length. Finally, the sand, which has been well rammed into the pipe, can be shaken out.


Wood top rail
1/2" Hook bolt
4 1/2" x 3"
Swivel
4' 0"
7 1/2"
STANCHION CLOSED
STANCHION OPEN
Anchor
Concrete


Tongue with slot in which latch engages
1" pipe
Latch
1" T-piece
Rivet connecting latch and operating handle
Slot in 1" pipe allowing travel for latch
1 1/4" pipe operating latch
1" pipe
Spiral spring
Paper packing
Rivet retaining spring


DETAIL OF HINGE
1" pipe
3/8" rivet
3/8" rivet
1 1/4" x 1/4" iron
3/8" bolt
1" pipe
1" pipe
9/16" hole
1 1/4" x 1/4" iron
1/2" mild steel

The bent portion of the stanchion carries a tongue inserted in its end, which can be made of a short length of ¾ inch steam pipe, forged to shape. This tongue has a recess to receive the latch when the apparatus is locked; this recess can be cut with a hack saw, and is about ⅜ inch wide and ⅜ inch deep. The latch itself is made of a short length of heavy ½ inch pipe flattened at one end and filed up to present a smooth surface to engage with the tongue. It is held up to its work by a spiral spring contained in the vertical 1 inch pipe, and is operated by a sleeve of 1¼ or 1½ inch piping, which must be free to move easily outside the 1 inch pipe. Sleeve and latch are connected by a ¼ inch rivet passing through both. The necessary travel is given by cutting a slot longitudinally in each side of the 1 inch pipe. Thus when the outer sleeve is grasped and pulled downwards, the spring is compressed and the latch withdrawn, allowing the tongue to be withdrawn from the 1 inch T in which it is enclosed in the locked position. The ordinary 1 inch T pipe fitting is screwed on to the top of the straight or swinging arm of the stanchion and gives rigidity to the whole when locked.

The main hinge is made of two pieces of 1¼ x ¼ flat iron rivetted to the straight pipe and the pivot is a straight ⅜ bolt passing through both pieces and also the end of the curved pipe. The swivels are made of short pieces of 1¼ x ¼ inch iron bent into a U shape and drilled to take attachments of ½ inch mild steel, which form the top and bottom fastenings.

The spiral springs should be fairly light; old Ford valve springs are excellent. The rivet which holds up the spring at the bottom should be placed about ½ inch too low. Packing of paper can then be placed above it and rammed down, until the spring has the required tension.

The stanchion can be made by anybody with the help of ordinary farm tools, drill, forge, vice, etc.

The first six which I made have been in use for over six months and have given complete satisfaction. It is thought that other farmers may be interested in this economical way of modernising the cow-byre.

The Ridger Grader.

By D. AYLEN and the Irrigation Department.

The implement here described has been devised to work in conjunction with a plough and ditcher or with a plough only with the object of facilitating the work of rebuilding old ridges which have become too low, widening existing narrow ridges so that they can be planted to a field crop, and constructing new broad ridges. Its usefulness in expediting such work has been demonstrated in a number of instances, and with the growing popularity of the broad type of ridge the need for such an implement has become increasingly evident.

It will not be out of place to recapitulate the advantages of the broad ridge, which are, briefly, as follows:—

(*a*) As the ridge can be planted to a field crop less land is wasted.

(*b*) They are more stable than the narrow ridge.

(*c*) The damage done by rats and the natives hunting for them is very considerably reduced.

(*d*) They can be kept as free from weeds as the rest of the land and therefore do not become a harbour for weeds from which the remainder of the land may become infested.

(*e*) They can be crossed by the lighter farm implements and ploughed along their length without danger.

(*f*) Their annual maintenance involves less work than that required on narrow ridges.

DESCRIPTION AND CONSTRUCTION OF RIDGE GRADER.

As will be seen in the accompanying drawing and photographs this grader consists of two flat wooden blades each 9 feet long. The two blades are of similar construction but are made right and left handed. The working face of each blade is covered with a strip of 3 inch x ¼ inch flat iron which forms the scraping edge.

A trailing pole to keep the blade at the correct angle with the ground surface is attached rigidly to the back of each blade by two iron brackets. The blades are held together by the towing chains which are connected in such a manner that the distance between the rear end of the blades can be regulated by moving a shackle backwards or forwards along the two inner chains. When necessary one or more natives may be required to stand on the trailing poles to regulate the amount of work done by each blade and a vertical handle is attached to each blade by which they can hold on.

The rear end of each blade is widened to prevent the soil overflowing by attaching a tapering plank which can be cut to the required shape by sawing a piece of 6 inch x 1½ inch timber diagonally.

The blades are stiffened by lengths of 2 inch x ¼ inch angle iron bolted along the lower edge of the 9 feet x 1½ inch planks.

Full details of the various metal fittings and how the complete blades are assembled is shown in the drawing and require no further description here.

A farmer having the necessary facilities and skill might make the whole implement himself, for although certain joints in the metal work would be welded in a fully equipped workshop, there is no reason why they should not be slightly modified by overlapping the ends to be joined so that the welding can be replaced by bolts or rivets.

It is suggested that those who are able to tackle the woodwork only should obtain the metal work from a local blacksmith and assemble the blades themselves on the farm.

It may be of interest to state that the total weight of the iron fittings is approximately 200 lbs. and that of the bolts 17 lbs.

HOW THE GRADER WORKS.

In operation the grader is drawn along with a blade on either side of the bank, the oxen walking along the top

Two views of the ridge grader making a new contour ridge.

Ridge grader raising a wide bank.

of the bank. In this way the surface soil which has previously been loosened and sufficiently broken up by the plough, is collected from near the toes of the bank and re-distributed either higher up the slope or on top of the bank, according to how the blades are adjusted. The blades should have practically no cutting to do and the implement is consequently comparatively light in draught. As a rule, where a bank is already in existence, the grader will tend to run straight, but if any guiding is necessary it can be done by one or two natives who mount the trailing pole and throw their weight on to the blade which tends to run too high up the bank. The natives soon learn the necessary manoeuvre when they have had a little experience of the work.

It will be found that the blades tend to close in when working on a low, broad bank and to run wider apart as the bank grows higher so that generally speaking it tends to broaden a narrow bank and heighten a low one, but the result required under any particular circumstances can be attained by the judicious adjustment of the shackles on the inner towing chains. It will be appreciated from the foregoing that by alternately ploughing the ground on either side of the bank and then collecting and grading up the loose soil thus made available, with the grader, a bank of any size within practical limits can be constructed. Should it be necessary to collect ploughed soil from beyond the normal reach of the grader, an ordinary ditcher can be used to push the soil nearer to the bank.

When rebuilding or enlarging an existing bank it is of course necessary to plough the surface of the bank itself after first clearing it of all weeds and trash to form a "key" for the fresh soil. Trash greatly reduces the efficiency of the implement.

When turning the grader at the end of the bank the oxen should make a fairly wide sweep and the outer end of the blade on the inner side of the turn should be pulled back as the chains slackens.

The ridge grader will be found a most useful implement for clearing the water channel of a ridge either when first constructed or after it has been rebuilt, and detailed instructions for performing this essential work are given in a later paragraph.

HOW THE GRADER IS USED.

A brief outline of how the grader should be used in performing some of the operation for which it is intended is given hereunder for general guidance.

Raising existing broad ridges which have been worked down.—Plough along the bank, commencing at the top, with the plough throwing in towards the centre until the whole of the bank and a strip a few feet wide on either side has been thoroughly broken up to provide loose soil free from big clods. Work the grader backwards and forwards along the bank until all the available soil is graded up on to the bank.

Loosen more soil by re-ploughing the ground on either side of the bank and again grade up. If still more soil is required plough fresh ground further from the bank, and if this is beyond the reach of the grader push it nearer to the bank either with the plough or preferably with an ordinary ditcher.

Widening Existing Narrow Ridges.—The sequence of operations is similar to that previously described for raising broad ridges, but if the existing ridge is sufficiently high the grader is adjusted to deposit the loose soil on the side slopes of the bank only. Ploughing and grading are repeated alternately until the bank is of the desired size and shape. In actual practice it was found that a total of 10 rounds, using each implement to the best advantage, more than doubled the width of an ordinary ridge having a base width of 8 feet, thereby making it suitable for planting with a field crop.

Important Notice.—Before deciding to remodel old narrow ridges so that they can be planted to a field crop, consideration must be given to the question as to whether the spacing of the ridges is suitable to the new conditions. At one time, before the practice of planting ridges was generally adopted, the banks were sometimes made relatively high and widely spaced. In nearly all such cases it will be necessary to build additional ridges between the existing ones, and technical advice should be obtained before any alterations are undertaken. It may be pointed out, however, that the annual maintenance of a narrow ridge protecting an unduly wide strip of land often involves nearly as much expenditure as that required to construct a new broad ridge.

Building New Ridges with Plough and Grader Only.—Plough up a strip 15 feet wide with the plough throwing towards the centre. Re-plough the same strip commencing in the centre to break up clods and to make as big a bank as possible to act as a guide for the grader.

Work the grader until all available soil has been collected and deposited in the bank. Re-plough the outer edges of the strip to deepen the cut and grade up the loosened soil with the grader.

Again work the plough, this time the rear disc cuts new ground and the other two deepen the cut already made and again grade up the soil thus made available.

If a still larger bank is required repeat the ploughing and grading as before the grader being opened to its fullest extent to collect the more remote soil and later, if necessary, being closed in to increase the height of the bank.

It was found in practice that a total of 18 rounds with the plough and grader used as described produced a well consolidated ridge with a base width of 18 feet, a crest width of 6 feet and a height of 22 inches above the bed of the water channel which had a bottom width of 7 feet.

Building Ridges with Plough, Ditcher and Grader.—Since the grader has definite self-tracking properties when running on a defined bank it is obviously an advantage to commence forming the bank at an early a stage as possible and it is for this purpose that a ditcher has its advantages.

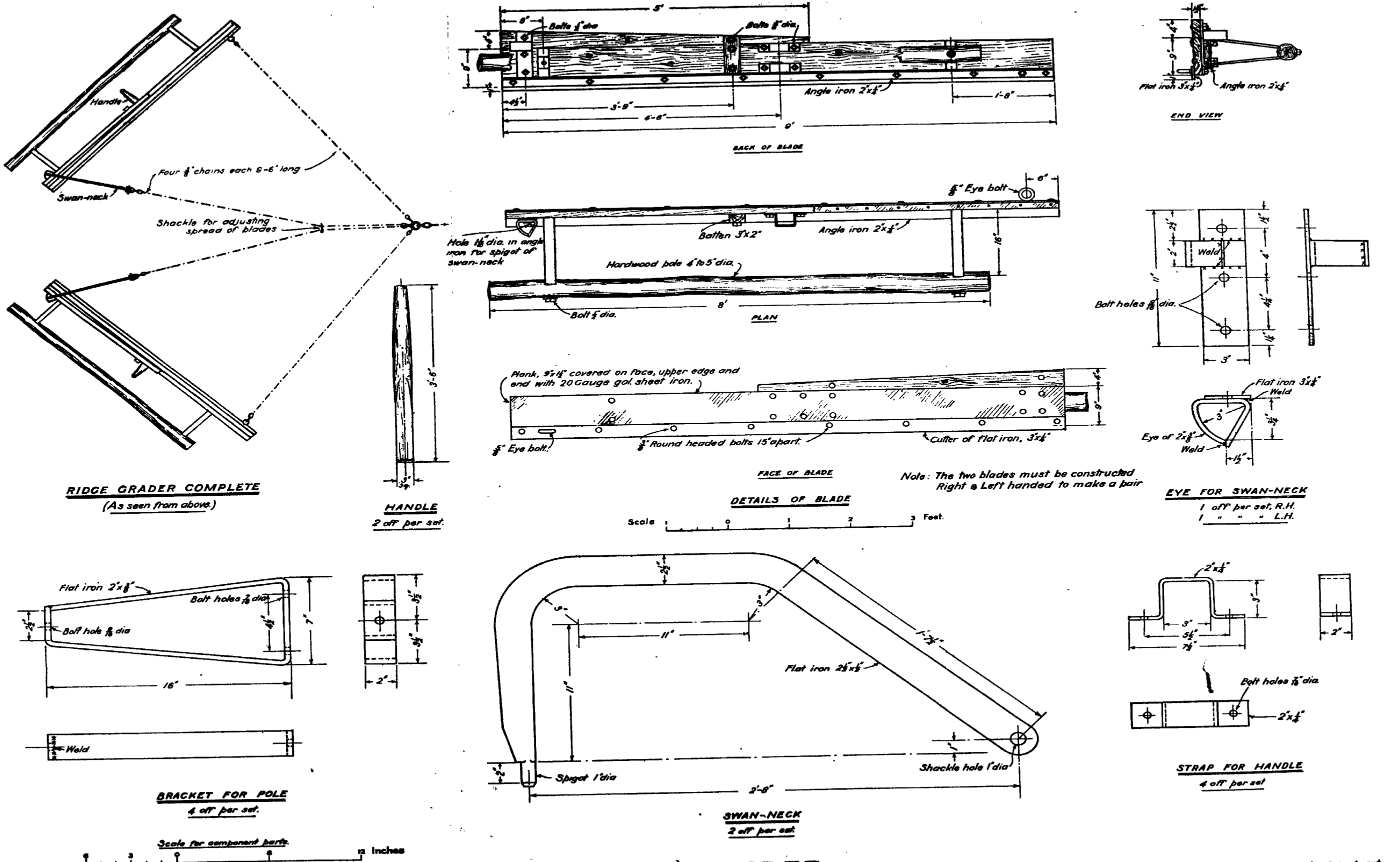
Firstly, therefore, plough a strip about 11 feet wide and grade the soil to the centre with the ditcher. Then widen the strip to about 15 feet with the plough and again grade up with the ditcher. Now use the grader to further raise and form the bank. Further alternate rounds with the plough and grader will enlarge the bank to the required size, the plough being used to widen and deepen the cut by taking new ground with the rear disc only, while the front discs deepen the previous cut.

If the ploughed strip is widened beyond the reach of the grader the ditcher may be used to push the ploughed soil nearer to the bank.

The Water Channel.—When a new ridge has been constructed or an old one re-built it is absolutely essential that the water channel should be cleared up and graded to render it fully efficient.

The bed must be smoothed and cleared of all loose clods and other obstructions which would impare its efficiency as a drain. For this operation the grader can be converted into an implement somewhat resembling a snow plough. The swan necks are removed and the chains detached. The blades are then placed back to back and their front ends brought together to form the pointed end of a "V." The rear ends are spread out to the required width and held apart by a light pole which is tied to the trailing poles. It is then dragged along the water channel by the chains attached to the front of the blades. If the blades tend to separate at the nose the chains can be bolted or lashed together just in front.

It should be noted here that particular attention must be paid to the water channel where it skirts ant-hills or other high spots. At such points the bed of the channel must be kept at the correct grade and *width*. If, as frequently happens, the bed is allowed to become higher than the normal grade or narrow at such points, the land above may become water-logged and the bank may fail completely.



— RIDGE GRADER —

Farming Calendar

APRIL.

FORESTRY.

Cultivate the soil in the young plantations either by means of machines or hand labour. The cultivation will conserve moisture. Hoed out weed growth should be applied as a mulch round the base of each young tree. Be careful not to pile earth round the stems of the young trees. Covering the stems with earth even for an inch or two interferes with the sap circulation and invites attacks by termites.

Steps should be taken to prepare seed-beds for the slower growing species, *i.e.*, pines, cypresses and callitris, and seed of these species may be sown from now until the end of June for planting during the coming rainy season.

CROPS.

Don't forget witchweed cultivation. If sufficiently mature, begin cutting and stooking early maize over a small acreage and plough up the ground whilst still damp between the rows of stooks. Early stooks must be small. Ride your manure and compost to the lands for spreading and ploughing under. If ripe, reap and husk early planted maize, and keep in a separate dump. Continue to make field selections of the best maize plants, and mark those required for seed with strips of coloured cloth. Lift any ground nuts and potatoes showing signs of making second growth. Make silage; cut maize for this when the ears are in the "dough" stage. Feed sweet potato vines to stock, reserving any new growth of vines for grazing in May. Plough in any green manure crops not already turned under. Plough fallowed land. Keep potatoes reserved for seed on racks in a cool place protected from frost, but well ventilated, and green them in subdued light. Pick over potatoes which may be lifted, and remove the bad and diseased ones. Winter cereal crops for grain can be sown towards the end of the month. Remember that good and deep ploughing to a depth of at least 7 to 8 inches is essential, and the basis of all successful arable farming. If the lands are not already ploughed so deep, increase the depth of ploughing about an inch a year until this depth, or even more, is reached. On lands which have been ploughed for a number of years at the same depth, use a grubber to stir up the sub-soil without lifting it to the surface. Too much attention cannot be paid to good tillage. It is usually good practice to follow the plough immediately with a harrow or other suitable implement to break down the clods before they bake hard. Continue breaking up new lands; the earlier this is done the more complete is the decomposition of the vegetable matter in the soil. When making hay of coarse legumes such as velvet and dolichos beans and cowpeas, be sure that the vines are dry before stacking. Handle the hay as little as possible to avoid loss of leaf. Lay in supplies of thatching grass for thatching and repairing roofs. The veld may be beginning to dry off. Consideration may be given to mowing or otherwise preparing fire lines as a preventive againt veld fires.

STOCK.

Cattle.—Where winter conditions are good, early spring calves may be weaned now, but a common practice is to allow them to run with their dams until the early rains. Where supplementary feed is available, April to June are probably the best months of the year for cows to calve in. These months also suit the dairy farmer. Provide succulent feed for the dairy herd. Dry off cows which will not pay for a grain ration during the winter. Bullocks for winter fattening should be selected from now on. Steers fat off the grass in April are easily and cheaply topped off.

The season of abundant green pasture is over, and the natural grazing, unless supplemented by some green food or succulent roughage, is not sufficient to maintain a full flow of milk. The most economical supplement to veld grazing at this time is maize silage or green maize, and this should be fed in liberal quantities to all milking cows and growing stock. A few pounds of concentrates in addition would also be of great benefit to the milking cows, which should not be compelled to subsist entirely on veld hay and silage.

Sheep.—See that ewes and lambs have sufficient feed and continue dosing for wireworms and bankrot worm.

DAIRYING.

At this season of the year the milking kraal is generally far from clean owing to the excessive amount of mud or dust which has accumulated during the latter part of the rainy season, and in consequence farmers invariably have trouble in producing first-grade cream. Every endeavour should be made to erect a small milking shed in which four or five cows or more can be milked at a time, and every effort should be made to keep the cows clean. The udders should be wiped before milking with a clean, damp cloth, and the farmer should see that the natives' hands are washed with soap and clean water before and after each milking.

If butter is made, the cream and washing water should be put out overnight, and if the cream is churned early the following morning, very little difficulty should be experienced in obtaining a good grain and a firm body in the butter.

From this time of the year onwards, cheese making operations are usually most successful. The evening's milk should not be kept in the dairy, but should be placed outside —preferably in a bath—and covered with butter muslin, cheese cloth or mosqito gauze netting. Care should always be exercised, however, in using evening's milk. Morning's milk plus a starter usually gives the best quality, and if a starter is used, care should be taken that it shows no signs of gasiness or off flavours.

FLOWER GARDEN.

The garden can generally be depended upon to make a good show in the autumn and early winter, provided that the plants have been previously kept in a healthy condition by watering, mulching and feeding. Snap dragons and other seedlings, also cuttings, may now be planted out into their permanent positions. Sowing may be made of hardy annuals, such as hollyhocks, larkspur, clarkia, pansy, petunia, sweet peas, gaillardia and candytuft. Bulbs of spring flowering plants may be taken up, divided and replanted.

VEGETABLE GARDEN.

Sow at once all that is required to fill up the vegetable garden before the soil has parted with all moisture. Seeds sown now will germinate freely, and plants will establish themselves more quickly than during the colder weather. which can soon be expected. A start should now be made at cleaning asparagus beds. This is a most popular vegetable, and yet one rarely sees it cultivated in the ordinary Rhodesian garden. It is supposed to be difficult to grow, but this supposition is not borne out, as, once established, a bed of asparagus is one of the most easily managed vegetables in the whole garden. Depth of good soil and plenty of manure are all that this plant requires. Rhubarb roots may be taken up, divided and replanted this month. Plant out from seed-beds cabbage and onion plants into their permanent quarters. Sow a full crop of peas, broad beans, turnips, onions, lettuce and radish.

POULTRY.

The first chicks should now be out, and these, having been hatched, must be well looked after. No food should be given for the first 36 to 48 hours. Leave them to sleep as much as possible. See that they have plenty of fresh warm air, but are not exposed to draughts. After 48 hours give some small grit and charcoal to purify the intestinal tract and aid digestion. A pamphlet dealing very fully with incubation and rearing of chickens can be obtained gratis on application to the Poultry Officers, Department of Agriculture.

One comes across many cases of wrong treatment of chickens in this country, the chief being uncleanliness, overcrowding, giving food too early and dirty drinking water. Two most important foods are animal protein, especially in the form of thick separated or whole milk and green food, especially onions or eschalots or their green tops. The loss in the rearing of chicks is very great; this should not be so if good breeding stock is used, the eggs from these are carefully handled and incubated and the chicks reared with care and common sense.

Any turkey chicks hatched at this time of the year should be well looked after. They should be kept warm, dry, free from insects, fed on dry food only, given plenty of thick separated milk, onions or onion tops, dry mash and grain. A pamphlet on turkeys and turkey rearing is obtainable from the Poultry Officers.

Ducks should do well during the month, the weather being as a rule cool, moist and bracing; but the houses in which they sleep must not be damp. Duck breeders should always be on the *qui vive* for a round worm called *Trichosoma contortum*, which is often fatal to ducks. It is found in the oesophagus, and causes arrest of growth, emacipation and weakness and sometimes epileptiform attacks. A swelling will be noticed at the lower part of the neck, which rapidly increases in size, and death occurs in one to three days. Onions, or preferably garlic, mixed with the food is a good preventive and cure. Another good remedy is essense of turpentine mixed with twice its quantity of olive oil and one or two tablespoonfuls given for a dose.

The Bed Bug and a New Aid for its Control.

WITH SPECIAL REFERENCE TO NATIVE QUARTERS.

By M. C. Mossop, M.Sc., Entomologist.

(*Concluded*).

SECTION III.

DEVELOPMENT OF A NEW AID TO CONTROL.

The knowledge that bed bugs tend to crawl upwards after a meal or when otherwise seeking shelter, and that they cannot crawl up or on the underside of a moderately polished smooth metal surface, suggests that a suitable barrier might be devised to confine bugs to the lower part of a room. So confined, they can be more easily treated, and they cannot escape to hide in crevices in or above the ceiling where they may be safe from fumigation or other treatment.

A knowledge of the bed bug's hiding habits further suggests that artificial hiding places could be supplied and the bugs periodically killed in them.

The Barrier.

An opportunity to test these suggestions occurred when two native dormitories were being erected by the Public Works Department to house employees at the Agricultural Experiment Station, Salisbury.

A bug barrier in the form of a horizontal shelf of galvanised sheet iron was fitted all around the walls inside the rooms, being let into the walls about eight feet from the floor (figure 2). The walls were plastered and the shelf projected

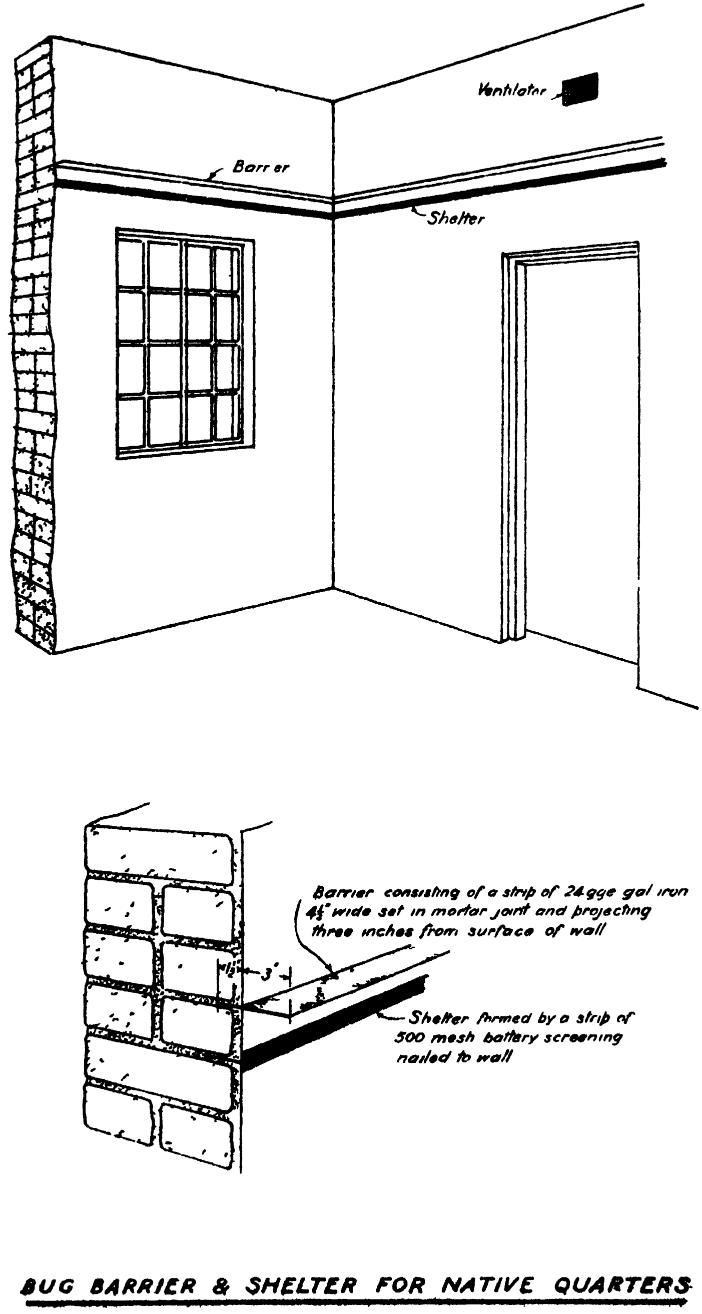

Ventilator
Barrier
Shelter
Barrier consisting of a strip of 24 gge gal iron 4½" wide set in mortar joint and projecting three inches from surface of wall
1½"
3"
Shelter formed by a strip of 500 mesh battery screening nailed to wall
BUG BARRIER & SHELTER FOR NATIVE QUARTERS

Fig. 2.—Bed Bug Barrier and Shelter.

three inches from them. Joints in the barrier were soldered smoothly, and the plaster where the barrier was let into the wall was carefully and closely finished off, especially on the under side. The object of the latter was to allow no crevices that would afford bugs hiding places in the wall at its junction with the barrier. After the walls had been plastered and whitewashed, the under side of the barrier was smoothed by being rubbed with sand and sacking.

The quarters were fitted with double-decker bunks to accommodate thirty natives in the two rooms. Each pair of bunks consisted of a framework of angle iron on which 13 loose $\frac{7}{8}$ in. x 6 in. planed sleeping boards rested transversely for each bunk. The iron frame at the head end of each bunk was let into the wall.

The roof of the building was of corrugated iron supported by unplaned wooden roof members which would normally provide excellent shelter for bed bugs. There was no ceiling.

The new building was occupied on 24th December, 1935, and it was decided to allow it to become heavily infested before taking any measures against bugs. Observations could meanwhile be made on the efficacy of the barrier.

About four months later, on 20th April, 1936, the rooms were examined and about fifty bugs were found, mostly in nests or groups immediately under the barrier or a few inches below it. It was expected that a few bugs would be found above the barrier, for it is sometimes possible for them to cross it along the soldered joints unless these are very smooth. But no bugs were found there.

The First Shelter.

It was now considered time to set up a shelter below the barrier. As the bugs that crawl up the wall do not necessarily halt when they reach and fail to cross the barrier, but crawl along the wall beneath it, it was thought that the shelter should be near the barrier in order that it would offer a convenient hiding place for the frustrated insects. But as it was intended to use a blow lamp regularly on the shelter, the latter should not be too near the barrier on account of the possibility of heat spoiling the close junction between the barrier and the plaster beneath it. A distance of three inches below the barrier was arbitrarily decided upon, and subsequently proved to be satisfactory.

The first shelter was therefore nailed to the wall three inches below the barrier, all the way round the room, on 20th April. It consisted of $\frac{3}{8}$ inch asbestos string, loosely chain-stitched to afford both easy foothold and crevices in which the bugs could hide.

When the shelters were examined on 7th May, large numbers of bugs (*C. lectularius*) had gathered under them. The shelters were treated with a blow lamp, and it is estimated that in one room, in which there were eighteen beds, about 900 bugs were killed and 100 or more escaped by dropping. Probably hundreds of eggs were also killed. Blow lamp treatment was applied to the shelter, with an occasional flick of flame on the wall between it and the barrier when bugs were seen there. Practically no bugs were seen on the wall below the shelter, and none above the barrier. The beds were not carefully examined.

A second treatment was given next day to kill bugs that had escaped from the first and had subsequently crawled back to the shelter.

A large measure of immediate relief was reported by the occupants of the dormitories, though they admitted that bugs were still present. Blow lamping on two successive days in each month was continued until the end of 1936, during the greater part of which period the writer was absent. In this period the number of bugs again increased, the infestation in December being almost as severe as it had been at the end of the first five months of occupation when no treatment had been given. In January, 1937, two double treatments instead of one were given, but the infestation was still heavy in February.

Examination revealed that large numbers of bugs were hiding in the bunks, especially where the angle iron frames were let into the walls. These joints had not been carefully plastered and afforded excellent crevices in which the bugs could hide. In March, therefore, all these crevices were filled with plaster of Paris so that bugs hiding in the bunks would be in a position more exposed to blow lamp treatment. Instructions were given that, in future, blow lamping would be done one day each week. As well as the shelters, the bunks were to be treated, the sleeping boards being removed and especial attention being given to the angles of the iron framework.

The Second Shelter.

At the same time the asbestos shelters were replaced by ¾ inch wide strips of fine mine battery screening having about 500 meshes to the square inch (figure 2). The asbestos string made good shelter for the bugs, but was wasteful of labour and fuel, as its insulating quality rendered blow lamping a tardy procedure and escapes numerous. The metal screening, on the other hand, could be blow lamped with greater speed and efficacy, and escapes therefrom were fewer.

In April, 1937, weekly blow lamping of the new shelters and the bunks commenced, the infestation being fairly heavy at that time. Results were satisfactory, and in December, when there would normally have been a considerable infestation, only one native occupant stated that any bugs were present. In a ten-minute search he failed to find any, but the writer found two in each room by driving them out of the shelter by means of quickly applied heat from the blow lamp.

The walls of the room, which had become badly spotted by excrement and squashed bugs during the first and unsuccessful attempts at control, were now whitewashed (December, 1937) so that their future condition would reveal any serious increase in the bed bug population. At the same time the under surface of the barrier was rubbed with coarse sacking to polish it, for one small unoccupied bug nest was found above the barrier, indicating that at some time the latter had been crossed. That was two years ago. At the present time the clean condition of the whitewash indicates that the position had been satisfactory during this period, for although a few excremental spots are present, there are no indications of bug nests on it.

A threatening increase in the infestation became evident in the spring of 1939 in one of the rooms, and could not be accounted for by differences in construction or appointments. It was, however, suspected and confirmed that the native in charge of the blow lamp invariably treated the other room first. Presumably he became less zealous before treating the second room, or else ran short of fuel without reporting the fact. After he was instructed to alternate the order of treating the rooms each week, the trouble disappeared.

A native in charge of the blow lamp is in any case inclined to become less vigilant when he does not see any bugs. To overcome this difficulty, the title "*Capitao wo Sikidzi*," in military parlance "O.C Bed Bugs," has been given to the officiating native to indicate both his responsibilities and the direction in which blame or ridicule is to be aimed by his colleagues in the event of an increase in the infestation.

BLOW LAMP TECHNIQUE.

The first lesson to be taught to the *Capitao wo Sikidzi* is, of course, the care and safe handling of the blow lamp. When he has mastered that, he needs instruction in its use against bed bugs. When the lamp is used on a metal gauze shelter, the flame should not be aimed at right angles to the shelter, for it is then inclined to spread outwards and drive out bugs that are some distance away. It should be directed slightly upwards, and pointing away from the direction in which it is to be moved. To make this clear, let us assume that the operator is facing the wall and shelter at right angles. He will then hold the lamp with the flame directed slightly upwards and, say, to the left, and he will move his arm holding the lamp in that position, in this case, towards the right. The centre of the flame should play about the lower portion of the shelter. Bugs are not then driven out of the shelter far ahead of operations. Those that are driven out will be near by, and they can be burned by directing the flame on them with a quick turn of the wrist.

Once he understands this, a native will soon develop a technique of his own.

USES OF THE BARRIER AND OF THE SHELTER.

Of the barrier and the shelter, the barrier can be used under a greater diversity of conditions. Its function is chiefly to confine bed bugs to the lower portion of the room in which it is fitted, and it is not necessarily used in conjunction with a shelter.

Confinement of the bugs to the lower portion of the room is of great importance in any normal room that requires treatment against bed bugs, except in rooms with plastered or otherwise bug proof ceilings. Rooms without ceilings, or with ceilings of wood, pressed steel sheets, or other material nailed in strips or sheets on to a framework, afford chinks in which bugs can hide or through which they can escape and so avoid treatment that is applied below. Rooms that are likely to become infested and in which the presence of the barrier is not undesirable could be fitted with the sheet metal barrier already described. Native quarters, prisons, permanent barracks and school dormitories are examples. Nothing that might touch articles below the barrier should be allowed to hang from above it.

In European bedrooms, and particularly in hotels and boarding houses, a continuous ornament shelf surrounding the room can unobtrusively act as a barrier if it is made of heavy polished metal sheet. Where ends abut, the crack so formed should be smoothly soldered over. If brackets are used to help support the shelf, which should in any case be let into the plaster, they should preferably be fitted above the shelf. If they are fitted below they should not project to the edge of the shelf, and should not be of a type that will afford deep shelter for bugs. Mosquito nets should be suspended from brackets fixed below the shelf, or they may be suspended from the ceiling if a highly polished ball or similar obstacle be interposed between the net and the ceiling.

Artificial shelters are of less general application than the barriers. The fewer alternative hiding places there are, the more effective will be the shelters. Except when there is a plastered ceiling, a shelter should be supplemented by a barrier. The purpose of shelters is to induce as large a proportion as possible of the bugs present to congregate in them in order to make treatment more convenient and effective. They are, therefore, only of use in rooms that have plastered walls and a minimum of furniture, and the occupants of which have simple tastes and few possessions.

So far, only heat treatment has been used against bugs hiding in artificial shelters. It is quite possible that either type of oil-pyrethrum treatment would also be effective, but it is not yet known whether regular treatment would render the shelter repellent to the bugs on account of odours. Heat treatment by means of a blow lamp is cheap, control in the two rooms in which trials were made, and which together housed thirty natives, having cost the price of eight gallons of paraffin oil and two or three bottles of methylated spirits per annum, plus labour and depreciation of equipment. Labour consisted of the services of one native every Saturday morning.

SECTION IV.

SOME ANTI-BED BUG SPECIFICATIONS FOR NATIVE ROOMS AND EUROPEAN QUARTERS.

The following should be borne in mind when rooms for native occupation are being constructed or maintained:—

Roof and Ceiling.—Preferably, a concrete roof smoothly finished beneath with plaster should be constructed. This affords good conditions should it be desired to fumigate, and it renders a bug barrier unnecessary. Where roofs are of iron, thatch, or tiles, ceilings, if fitted, should be of cement plaster on expanded metal. Other type of ceilings assist in fumigation only if they are made bug proof or if an effective bug barrier is fitted.

Walls.—Walls should be plastered smoothly, and, if not under a well plastered ceiling, should have a metal barrier as described in Section III. and shown in figure 2. As far as possible, the barrier should be *beneath* air bricks and windows, but would normally pass above the door. (If the threshold is raised on the inside and it is desired to bring the barrier below the door, the barrier can be brought down near the sides of the door and fitted in an upright position along the inner face of the threshold.) When it is necessary to bend the barrier in order to take it over or under an obstruction, the bends should be made in smooth round curves, not sharp angles. Alternatively, the barrier can be made to slant up to surmount an obstacle. The under side of the barrier should be polished at least once a year.

Shelters of 500 mesh battery screening should be fitted (figure 2) where desirable (see Section III.). Windows that are below the barrier, and doors, should preferably be of steel. Walker & Dixon (1936) advise that doors be swung without door-frames by means of pins at top and bottom.

Walls should be coloured white to reveal bug nests that may be made on them.

Floor.—No particular observations have been made in regard to floors, but it would seem that smooth cement or similar floors would afford the least shelter for bed bugs, especially if the arris is rounded.

Furniture.—Bed frames or bunks should be of metal piping without visible seams and with smoothly welded joints. If they are let into the wall, the plaster should be snugly and smoothly finished off around the junction, and the metal should be let in far enough to check any tendency for it to become loose. The lower part of the legs of the bedsteads should be polished with emery cloth occasionally to prevent bugs from crawling up, or circular metal barriers can be soldered on to them. Open ends of the piping should be sealed, or other means taken to prevent bugs from hiding inside it.

Other furniture should be as scanty and free from crevices as possible. Much of it can be prevented from affording habitual hiding places for bugs by fixing a metal barrier in the legs or by standing them in tins of water on which a film of oil is made to float.

European Quarters.

Anti-bed bug specifications for European quarters are based on the same principles as those for native rooms, but need to be modified to suit circumstances. The ideal modifications are expensive.

A ceiling that allows no bugs to pass through is even more necessary than in native rooms if there is a likelihood of infestation, for more complete control is usually called for in European houses than in native rooms, and it is difficult to *eradicate* bugs if the ceiling is not bug-proof and reasonably gas-tight.

In the dormitories of such buildings as schools and barracks, barriers can be fitted, and, if necessary, modified for the sake of appearance. In making any modification, however, it must be remembered that the object of barriers is to prevent bugs from crossing them, and the inclusion of hiding places either below or above them that may be inaccessible in control operations should be avoided. Such a modified barrier could take the form of sheet metal, half round in cross section, *both* edges being let into the wall and snugly plastered.

If an ornament shelf is to be fitted to the walls, it can take the form of a barrier as suggested in Section III. The picture rail, if under a bug-proof ceiling or under an ornament shelf or other form of barrier, should be of polished metal tubing held away from the wall by plain round-stemmed polished metal brackets with highly polished bases, similar to those locally popular for towel rails. The base of the bracket should make perfect contact with the wall. Such a rail offers no harbourage for bugs.

Wall paper is not undesirable as long as it remains in good condition, but it may easily lead to considerable trouble.

Skirting boards should be avoided where possible. If fitted, they should be carefully sealed to the wall and floor.

Electric switch boxes and fittings should be bug-proof.

A cement or similar floor is not always desirable, but a well laid hardwood floor can take its place. This can be laid to within two or three inches of the walls, and then closely followed on with cement which is rounded at the corner and brought upwards to form a skirting.

ACKNOWLEDGEMENTS.

The writer wishes to express his indebtedness to the Public Works Department for ready assistance by the inclusion of experimental barriers in the rooms concerned, and to his colleagues in the Division of Entomology and the Manager of the Agricultural Experiment Station, Salisbury, for assistance in various ways.

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Correction.- In the article Bed Bug Control in our February issue figure 1 was printed as "The Common Bed Bug . . . (after McKenny-Hughes)." This should read "The Common Bed Bug . . . (after Gibson and Twinn)."

Rhodesia Weather Bureau.

JANUARY, 1940.

PRECIPITATION.

Station	Inches.	Normal.	No. of days
Beitbridge	2.17	3.21	4
Bindura	3.38	7.39	10
Bulawayo	5.70	5.61	8
Chipinga	5.98	10.38	7
Enkeldoorn	6.00	7.63	8
Fort Victoria	1.83	6.14	7
Gwaai Siding	3.77	5.41	4
Gwanda	2.62	5.53	7
Gwelo	4.12	5.99	10
Hartley	2.35	7.74	9
Inyanga	5.06	9.92	13
Marandellas	2.19	8.56	12
Miami	8.38	8.25	14
Mount Darwin	1.93	8.25	9
Mount Nuza	7.15	14.59	20
Mtoko	2.32	7.77	6
New Year's Gift	3.30	7.65	7
Nuanetsi	2.80	4.33	4
Plumtree	2.05	6.30	6
Que Que	2.07	6.83	9
Rusape	2.64	7.56	9
Salisbury	4.65	7.37	12
Shabani	3.20	5.87	7
Sinoia	5.77	8.14	9
Sipolilo	5.57	8.52	14

Station.	Inches.	Normal.	No. of days.
Stapleford	7.09	16.81	19
Umtali	1.64	8.11	8
Victoria Falls	2.42	6.95	9
Wankie	2.15	6.49	9
Abercorn	9.87	—	20
Broken Hill	7.44	—	17
Chinsali	11.23	—	25
Choma	2.71	—	11
Fort Jameson	10.95	—	17
Fort Rosebery	9.35	—	20
Isoka	10.18	—	17
Kalomo	2.60	—	11
Kapiri Mposhi	9.65	—	18
Kasama	13.10	—	27
Kasempa	6.90	—	18
Luengwa	2.79	—	15
Livingstone	4.03	—	9
Lusaka	5.74	—	18
Mankoya	3.85	—	11
Mazabuka	1.90	—	3
Mkushi	5.35	—	12
Mongu	4.24	—	19
Mpika	11.68	—	23
Mporokoso	16.06	—	29
Mufulira	11.24	—	20
Mumbwa	4.09	—	15
Namwala	3.45	—	8
Ndola	15.59	—	21
Senanga	4.47	—	14
Sesheke	2.71	—	8
Shiwa Ngandu	11.97	—	27
Solwezi	11.11	—	10

JANUARY, 1940

Station.	Altitude (feet)	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F.														PRESSURE MBS.			Cloud Tenths.	Sunshine hours.
		8.30 a.m.							Absolute.		No. of Days.									
		Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min. ÷ 2	Maximum. Date.	Minimum. Date.	Max. > 85°	Max. < 70°	Min > 65°	Min. < 40°	Mean of 24 hrs.	8.30 a.m. Station Level.	8.30 a.m. 1200 gdm.	Mean of 24 hrs		
Beitbridge	1,486	79.6	69.4	64	13.9	93.7	69.9	81.8	104:21	55·24	29	—	27	—	81.3	962.6	882.4	960.5	4.8	—
Bindura	3,700	71.5	65.5	63	7.2	82.2	62.9	72.5	86·9	58:3	1	—	5	—	—	890.5	—	—	4.6	—
Bulawayo	4,393	69.8	62.4	58	8.4	81.4	58.9	70.1	87:10	53:14	8	1	—	—	70.4	868.5	879.8	866.9	—	9.9
Chipinga...	3,685	71.0	64.8	62	7.4	79.2	61.2	70.2	90 21	55.v.	2	3	2	—	70.2	890.8	880.3	—	4.2	—
Enkeldoorn...	4,808	69.0	62.2	58	7.6	80.9	58.5	69.7	87.8	51·14	6	1	—	—	—	856.2	879.8	—	3.8	—
Fort Victoria	3,571	73.1	64.5	60	10.6	83.7	61.0	72.3	91 8	55:v.	14	1	5	—	72.4	895.1	881.1	893.6	4.3	—
Gwanda...	3,233	74.9	64.6	58	10 5	88.1	64.4	76.2	95 9	54 24	2	14	1	—	75.7	904.8	880.4	902.8	3.6	—
Gwelo	4,629	70.2	63.1	59	8 3	81.7	59.3	70.5	88·9	54·24	8	1	—	—	69.5	861.2	879.6	—	4.6	—
Hartley	3,879	72 3	65.0	62	8.9	83.2	61.2	72.2	89.8	54 14	8	—	2	—	71.1	884.3	879.7	—	3.7	—
Inyanga	5,503	68 1	60.6	56	8.2	74 2	55.4	64.8	79:21	47.4	—	3	—	—	—	—	—	—	4.2	—
Marandellas	5,453	66.5	60.5	57	6.7	76.2	57.3	66.8	82 18	52·24	—	1	—	—	65.6	—	—	—	3.0	—
Miami	4,090	68.4	64.9	63	4 2	79.2	61.5	70.4	84:21	57:4	—	—	1	—	68.6	877.5	879.5	875.8	7.2	—
Mt. Darwin...	3,179	72.0	66.8	64	6.7	82.8	64.4	73.6	87:9	58:5	4	—	13	—	—	—	—	—	6.0	—
Mount Nuza	6,668	58.0	55.8	54	2.1	64.6	51.9	58.3	76·21	43:24	—	28	—	—	58.1	801.0	879.5	—	7.2	—
Mtoko...	4,136	70.2	63.6	60	7.5	80.0	61.4	70 7	84:8	56.4	—	—	2	—	69.9	876.6	880.2	875.2	5.2	—
New Year's Gift ...	2,690	74.9	67.1	64	10.0	85.6	61.5	73.5	97:21	54:4	18	—	3	—	—	—	—	—	—	—
Nuanetsi	1,547	79.1	69.9	66	12.5	95.2	67.0	81.0	104:21	53·24	29	—	21	—	—	960.3	881.6	—	3.9	—
Que Que...	3,999	70.9	64.4	61	7.6	83.8	61.2	72.5	89:9	55:7	15	—	1	—	69.2	880.7	879 9	879.1	4.7	—
Rusape	4,648	69.3	62.8	59	7.4	79.3	58.6	68.9	86:9	53·3	3	1	—	—	67.6	—	—	—	4.3	—
Salisbury	4,831	68.5	62.5	59	7.5	79.5	58.5	69.0	83:1	51·14	—	—	—	—	68.1	855.2	879.7	853.8	5.5	9.2
Sinoia	3,795	71.8	66.8	64	6.4	82.5	61.6	72.0	87:5	56.14	1	—	—	—	—	—	—	—	4.2	—

JANUARY, 1940 (continued)

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F. 8.30 a.m. Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min. ÷ 2.	Absolute. Maximum Date.	Minimum. Date.	No. of Days. Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hrs	PRESSURE MBS. 8.30 a.m. Station Level.	1200 gdm. 8 30 a m	Mean of 24 hrs	Cloud Tenths.	Sunshine hours.
Stapleford	5,304	63.7	60.5	58	3.3	71.8	53.5	62.7	81:21	44:4	—	7	—	—	62.4	—	—	—	5.6	—
Umtali	3,672	70.6	65.3	63	6.5	82.7	62.4	72.5	93:22	55:4	9	—	5	—	70.8	891.6	880.7	890.4	5.0	—
Wankie	2,569	77.5	69.3	65	11.0	95.2	68.5	81.8	101:17	65:v.	30	—	28	—	—	925.8	880.3	—	3.3	—
Abercorn	5,458	64.4	61.3	59	3.4	73.7	57.3	65.5	79:16	54:21	—	2	—	—	63.1	837.7	880.6	—	8.8	—
Broken Hill	3,911	69.4	65.5	63	4.6	79.9	61.5	70.7	85:18	58:9	1	—	—	—	69.4	883.2	879.4	—	7.2	—
Fort Jameson... ...	3,815	70.5	65.7	64	5.9	79.1	63.7	71.4	86:8	57:6	2	1	3	—	69.5	886.7	880.5	885.0	6.6	—
Fort Roseberry ...	3,830	66.7	64.6	64	2.3	77.8	62.5	70.2	83:17	57:7	—	1	2	—	68.2	—	—	—	—	—
Kasama	—	66.0	63.6	62	2.7	77.1	61.2	69.1	81:18	58:23	—	1	—	—	66.5	863.8	880.2	—	8.3	—
Kasempa...	4,500	64.8	63.7	64	1.1	78.9	58.8	68.8	85:15	51:16	—	—	—	—	—	—	—	—	—	—
Livingstone...	3,051	73.7	68.2	65	7.0	87.7	63.7	75.7	93:17	59:15	24	—	10	—	74.8	906.2	879.0	904.4	3.7	8.3
Loangwa Bridge ...	1,330	75.1	71 7	70	4.8	90.1	70.5	80.3	97:18	67:4	26	—	31	—	78.2	—	—	—	—	—
Lundazi	3,590	68.1	65.8	65	2.8	79.2	61.9	70.5	84:21	57:7	—	—	1	—	68.9	—	—	—	—	—
Lusaka	4,193	68.7	64.7	63	4.7	78.3	61.8	70.0	84:8	58:4	—	—	—	—	—	873.9	879.2	—	7.1	—
Mongu	3,481	72.3	68.0	66	5.5	84.6	66.1	75.3	90:17	63:23	15	—	21	—	73.7	895.8	878.9	874.2	4.5	—
Mpika	4,620	65.5	63.8	63	2.0	76.4	60.3	68.4	84:19	56:7	—	—	—	—	67.0	861.9	880.7	—	—	—
Msoro	3,030	72.7	70.0	68	3.7	85.8	66.9	76.3	91:19	60:7	19	—	25	—	74.3	—	—	—	—	—
Mumbwa...	3,500	69.8	65.9	64	4.7	82.7	64.9	73.8	89:19	61:17	6	—	12	—	72.5	—	—	—	—	—
Mwinilunga...	4,450	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ndola	4,190	66.9	64.5	63	2.9	79.5	61.4	70.4	85:9	56:8	—	—	—	—	—	874.9	879.9	872.9	6.7	—
Chileka	2,600	73.7	69.1	67	6.2	80.5	66.3	73.4	86:21	60:5	1	—	22	—	72.3	926.6	880.8	—	7.2	—

Rainfall in January, 1940, in Hundredths of an Inch. Telegraphic Reports.

Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	Normal
1	6	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	17	48	27	3	6	32	...	...	..	...	...	...	...	130	27	298	533
2	7	1	...	...	...	...	...	...	...	...	69	4	..	...	...	...	...	64	31	19	34	38	1	...	...	...	...	...	2	79	37	386	742
3	24	...	...	...	...	...	...	. .	24	15	170	23	..	..	..	..	...	...	1	...	13	291	...	...	...	...	...	5	1	31	93	691	1087
4	2	...	...	...	...	...	...	4	...	..	13	...	...	...	.	.	1	7	101	22	29	63	...	1	...	...	...	4	7	95	96	445	697
5	...	2	2	...	...	...	...	...	3	...	3	...	...	..	...	6	2	14	...	...	40	31	1	...	...	6	15	...	...	76	20	221	663
6	...	2	...	...	...	...	1	..	...	3	14	...	...	...	.	...	19	1	76	...	37	53	...	10	...	...	...	24	10	8	52	311	746
7	1	15	...	...	...	...	1	7	...	3	2	37	2	..	2	2	5	2	19	66	4	61	...	1	...	..	2	9	5	43	46	335	911
8	20	4	...	...	...	...	19	17	23	10	82	41	...	6	...	1	2	58	28	15	18	46	7	.	..		1	18	...	...	14	430	835
9	...	12	...	...	...	...	13	29	11	36	69	75	3	23	5	...	...	18	33	15	7	99	30	...	...	..	1	4	...	14	30	527	855
10	...	...	...	...	...	...	...	27	...	47	1	7	1	...	..	...	...	...	4	14	...	33	1	...	...	. .	...	16	...	1	61	213	824
Mean	3	4	...	...	...	..	3	6	3	9	25	16	1	3	1	1	6	24	33	15	21	52	5	1	...	1	3	6	3	62	40	347	730

Southern Rhodesia Veterinary Report.

DECEMBER, 1939.

DISEASES.

African Coast Fever was diagnosed on the farm Witpenshoek in the Salisbury native district.

TUBERCULIN TEST.

Thirteen bulls, two cows and ten heifers were tested on importation. There were no reactions to the test.

MALLEIN TEST.

Twenty-three horses and twelve mules were tested with negative results. The horse from Natal which gave a suspicious reaction the previous month is being detained for a further test.

IMPORTATIONS.

From Union of South Africa.—Bulls 17, cows and heifers 9, horses 23, mules 12, sheep 1,035, pigs 17.

From South West Africa.—Bulls 10.

From Bechuanaland Protectorate.—Sheep 278, goats 80.

EXPORTATIONS.

To Portuguese East Africa.—Cattle 52, sheep 42, mules 10.

To Belgian Congo.—Horses 6.

To Northern Rhodesia.—Donkeys 13, sheep 42.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom.—Frozen beef quarters (chilled quality), 6,187; frozen boneless beef quarters, 31.

To Northern Rhodesia.—Frozen beef carcases, 67; frozen mutton carcases, 52; frozen veal carcases, 5; offal, 3,204 lbs.

To Belgian Congo.—Frozen beef carcases, 197; frozen mutton carcases, 21.

Meat Products from Liebig's Factory.

To Union of South Africa.—Corned beef, 1,752 lbs.; beef paste, 293 lbs.; sausages, 496 lbs.

To Bechuanaland Protectorate.—Corned beef, 1,440 lbs.

To United Kingdom.—Meat extract, 5,964 lbs.; beef powder, 2,367 lbs.

B. A. Myhill,
Chief Veterinary Surgeon.

Southern Rhodesia Veterinary Report.

JANUARY, 1940.

DISEASES.

African Coast Fever was diagnosed on the farms Shinghaini, Geluk and Argyll Ranch in the Salisbury native district.

TUBERCULIN TEST.

Six bulls and four heifers were tested on importation, there were no reactors. Eight bulls were re-tested with negative results.

MALLEIN TEST.

Two horses and eight donkeys were tested during the month. There were no reactors.

IMPORTATIONS.

From Union of South Africa.—Bulls 6, heifers 4, horses 2, sheep 1,316.

From Bechuanaland Protectorate.—Sheep and goats 669, pigs 24.

EXPORTATIONS.

To Portguese East Africa.—Oxen 56, donkeys 101.

To Northern Rhodesia.—Bulls 2, sheep 45.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom.—Frozen beef quarters, chilled quality, 10,047; frozen boneless beef quarters, 84; livers, 37,726 lbs.; hearts, 11,520 lbs.; tails, 10,705 lbs.; skirts, 8,116 lbs.; shanks, 521 lbs.; kidneys, 186 lbs.; glands, 278 lbs.; fat, 1,293 lbs.; cheeks, 5,618 lbs.

To Palestine.—Frozen beef quarters, 356.

To Belgian Congo.—Frozen beef carcases, 26; frozen mutton carcases, 6; offal, 138 lbs.

To Northern Rhodesia.—Frozen beef carcases, 27; frozen mutton carcases, 41; frozen veal carcases, 4; offal, 2,081 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa.—Corned beef, 2,148 lbs.; beef fat, 24,000 lbs.; beef paste, 8,190 lbs.; sausages, 525 lbs.

To Bechuanaland Protectorate.—Corned beef, 720 lbs.

To Basutoland.—Corned beef, 288 lbs.

B. A. MYHILL,
Chief Veterinary Surgeon.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than by stamps.

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Date.........................19.....

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Salisbury.

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Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).
PUBLISHED MONTHLY.

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VOL. XXXVII.] APRIL, 1940. [No. 4

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Ensuring the Supply of Sound and Reliable Seed.—The formation of Seed Associations has been a live issue with the agriculturist for many years. Wide publicity has been given to the subject in the local press and at meetings and much spade work has already been done. Unfortunately farmers have proved most apathetic in the matter. We say "unfortunately" because growers have wasted time in thinking about it and we fear will waste more time talking about it. There has never been a time like the present and when an ounce of voluntary effort is worth a ton of compulsion. The present war calls for every ounce of effort from producers on the land in the British Commonwealth of Nations and our Allies. Maximum economic production is a vital front in the present struggle. The supply of pure seed to farmers commercially is of the greatest importance to the agricultural industry. Good seed is a link in the chain of production, and we must ensure an independent and adequate supply to enable us to pull our full weight. Inferior and diseased seed can only result in crop failures.

As pointed out above, Seed Associations are long overdue, and time, particularly in the present crisis, is priceless. We can quote no better case in support of our views than the article on "The Health of Seed Potatoes" which appears in this issue.

Plant Diseases in Southern Rhodesia.—A descriptive list of plant diseases in Southern Rhodesia and notes on their control has just been published as Memoir No. 2 of the Department of Agriculture. This list has been compiled by Dr. J. C. F. Hopkins, the Senior Plant Pathologist, and may be obtained from the Controller of Printing and Stationery, Salisbury, at 1s. 6d. per copy. The list occupies some 50 pages of print and the commonest diseases of some hundreds of our native plants and cultivated crops are briefly described and, in many cases, control measures are indicated. As mentioned in the introduction further details of control measures can be obtained on application to the Senior Plant Pathologist, Box 387, Salisbury. The plants are arranged alphabetically according to their scientific names, but no difficulty should be experienced on this account, as a list of common names is given at the beginning of the Bulletin. This is the first time such a comprehensive list of our common plant diseases has been produced, and it should prove to be of the greatest interest not only to plant pathologists but to every farmer and gardener.

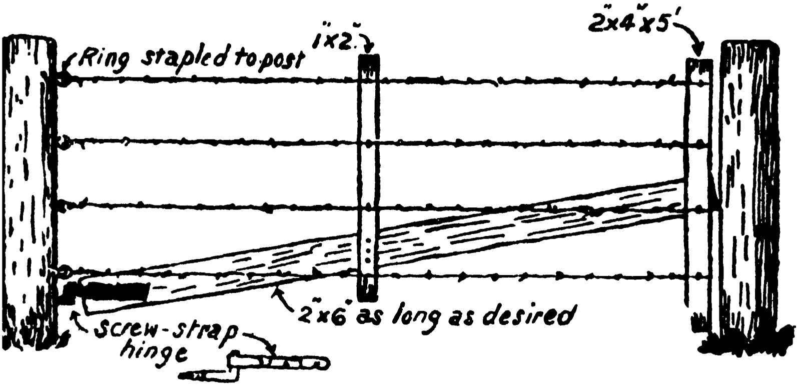
Autumn Cleanliness.—The programme of Agricultural Cleanliness suggested for April and May may appear formidable, especially to those whose labour is engaged in other pressing duties during these two months. With a certain decrease in effectiveness, some of the work can be postponed, but this should not be done unless such action is dictated by necessity.

Fairly complete suggestions appeared in these pages in April and May of last year, and should be referred to. They include the early and complete uprooting of tobacco plants, routine cleaning of tobacco sheds and disposal of refuse, cleaning of tobacco barns after their last firing and attention to the seed-beds and volunteer tobacco plants that may have sprung up mysteriously anywhere on the farm. They also include the low cutting of maize plants, collection of fallen and stung fruits, destruction of all unwanted plants of the cabbage family, and early commencement of ploughing.—*Cleanliness Aids Insect Control.*

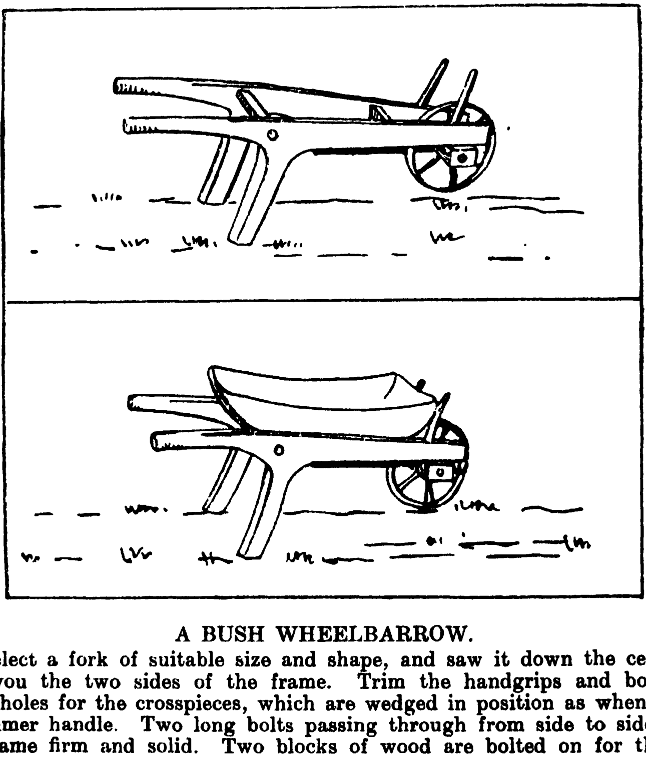
The Eucalyptus Snout-Beetle in Rhodesia.—For some years the appearance of the Eucalyptus Snout-Beetle, *Gonipterus scutellatus*, Gyll., has been expected in Southern Rhodesia. This beetle, both in the grub and beetle stage, attacks the foliage of eucalyptus trees, and is most serious on *E. globulus*, *E. maideni* and *E. viminalis*. Although the insect was not discovered in the Union of South Africa until 1916, it is believed that it was introduced accidentally from Australia ten years before. In 1926 a parasite of its egg, *Anaphoidea nitens*, Gir., was officially introduced into the Union to combat the pest. Now the presence of both the beetle and its parasite has been discovered at Penhalonga, and it is probable that they have been there for several years.

In 1927 both the beetle and its parasite were discovered to be present in the southern portion of Nyasaland. It is possible that the Penhalonga infestation preceded the Nyasaland one and served as a stepping stone in the spread of the beetle to Nyasaland from the Union. If this is so, it is probable that other plantations in Southern Rhodesia are affected.

It is hoped to publish a fuller account of the insects at a later date.



AN IMPROVED WIRE GATE.
An improvement on the ordinary "Concertina" type of wire gate.



A BUSH WHEELBARROW.

Select a fork of suitable size and shape, and saw it down the centre to give you the two sides of the frame. Trim the handgrips and bore two auger-holes for the crosspieces, which are wedged in position as when fitting a hammer handle. Two long bolts passing through from side to side make the frame firm and solid. Two blocks of wood are bolted on for the axle to run in, and a bitumen drum in one piece forms the body.

(Queensland Agricultural Journal, October, 1939.)

Farming Calendar

MAY.

FORESTRY.

Start pricking out seedlings into tins. Deciduous trees which are propagated by means of cuttings should be taken in hand. See that the fire lines are in order, and in the case of woods which have formed canopy, remove inflammable material below the edge trees.

CROPS.

Witchweed may still require attention on the stooked lands. Continue to cut and stook maize as it matures; make the stooks small to assist drying and prevent increase of diplodia. Later in the season the stooks may be made larger. See that the stooks are secure and pick up plants lying on the ground. Continue to plough up land between stooks of maize. Give all maize harvested, whether husked or in the husk, a chance to dry out before riding to the dumps. Do not begin shelling if the ears are still damp. Do not use new grain bags for harvesting maize. Make the dumps of unhusked ears as small as possible; the smaller the dump the quicker the grain will dry out. Grain on the cobs dries extremely slowly, if at all, in dumps of large size. Do not mix unhusked ears from the stooks with dryer ears harvested later from the standing crop. Keep the dryer ears in a separate dump; shell, bag and stack such maize separately. When cutting maize for stooking, insist on the stalks being cut at ground level. The plough, in Rhodesia, will not bury roots with stalks 8 to 12 inches high. A long stubble of stalks makes clearing of the ground for ploughing very tedious and expensive. If not already harvested, ground nuts should be lifted before the first frosts damage the hay. Sow most winter cereals on wet vleis or under irrigation early this month. Feed your sweet potato vines to stock; if frosts occur the vines will be killed. Dig and feed tubers from end of month onwards. Towards end of month harvest cattle pumpkins and melons and handle carefully; avoid bruising to prevent rotting. Place pumpkins and melons in a dry situation in the open and in a single layer. Supply plenty of roughage to cattle pens, kraals and stables to increase the manure supply. Collect and cart manure to lands for spreading. Do not attempt to plough in dry grass or quantities of maize refuse. The plough will not turn it under and it will not rot before planting season. Burn such refuse and make a good job of the ploughing. If the weather seems set fair, commence brickmaking. A small kiln of bricks always on hand is most useful. As labour permits, re-thatch buildings and outhouses in need of repair. Overhaul, grease and paint planters, drills and other implements not required again until next season, and store away under cover. Think about your fertiliser requirements for next season and place your orders. From now onwards the second ploughing of new land broken up earlier in the season should be pushed on with as opportunity offers.

STOCK.

Cattle.—By the middle of this month dairy cattle will require more serious attention in the matter of feed. Grass should be cut for bedding, and both cows and calves, if the weather is too cold, should be well bedded down at night from now onwards, and cowsheds should be put in good repair. Attention should be given to the water supplies, and care taken that they are clean and sufficient.

Boggy sources of water supply are a frequent source of loss of cattle during the winter months. With adequate water supplies cattle can withstand considerable shortage of grazing. Weaners should be fed a good roughage ration—with or without a small allowance of grain, depending on circumstances—to keep them growing through the winter months.

Get in the bullocks for winter fattening.

Sheep.—Especially from now on the ewes and lambs should have adequate feed such as green oats and barley or bean hay and a little maize. This will ensure an adequate supply of milk and hence good thrifty lambs. Dose for nodular worm.

DAIRYING.

At this time of the year the farmer should experience very little difficulty in producing cream of first-grade quality. During the winter months the separator should be adjusted so as to deliver cream testing 40 per cent. butter fat.

On exceptionally cold days care should be taken that the milk is not allowed to become too cold before separation—for efficient skimming, the milk should be separated immediately after milking and at a temperature not lower than 90 degrees F.

Farmers engaged in butter-making are usually successful in obtaining a good grain and firm body in butter at this season of the year. During cold weather it is frequently necessary to warm the cream for churning. The most satisfactory method of warming the cream to the proper churning temperature is to place the bucket or receptacle containing the cream in a tub or bath of water at a temperature of about 95 degrees F., stir the cream frequently and replace the water when cold.

Under the cool conditions which obtain from this time of the year onwards, cheese-making operations are usually most successful.

Care should always be exercised, however, in using evening's milk. If the milk is over-acid it should not be used, or a hard, dry cheese will result. Morning's milk plus a starter usually gives the best quality of cheese. The starter should have a clean sour taste and smell. In early winter, milk for cheese-making frequently contains a high percentage of fat, and in order to firm the curd properly in the whey it is usually necessary to raise the scalding temperature a few degrees.

VEGETABLE GARDEN.

It will be necessary during the early part of the month to clear off what remains of summer crops, such as haricot beans, peas, cucumbers, etc. Where winter deep rooting vegetables are to be grown, such as carrots, parsnips and beets, the soil and sub-soil should be deeply worked, so as to allow a ready root run for these vegetables. A dressing of lime will be of great value in every section of the kitchen garden. This will especially help to minimise future attacks of insects and fugus attacks. New asparagus beds may be made this month; old beds should be cut down, cleaned and kept in good order; also a light dressing of stable manure may be given to the beds. Planting may be made of all seedlings, such as cabbage, cauliflower, lettuce, onions, etc., and seeds of carrots, leek, lettuce, onions, peas, radish, turnip, parsnip, broad beans may be sown.

POULTRY.

All cockerel chickens should be separated from the pullets, and every month gone over carefully, the poorer ones eliminated and only the very best kept. Those cockerels with the deep long bodies, short legs and round heads should be kept. Those with any inclination to long legs, knock knees, long heads or thin beak, lop-over combs, narrow bodies, or those lacking length and depth should be rigorously discarded. The chickens must not be allowed to become chilled, especially at night; on the other hand, they must not sleep in a hot stuffy atmosphere. On no account must they be overcrowded; this is fatal and is one of the many rocks on which poultry keepers come to grief.

The young stock must have all they can eat; to stint them is to ruin them for good and all. A bird that has been stunted never recovers. A good quality bone meal (lime phosphate) is absolutely necessary, as is also plenty of succulent green food, and no animal protein is better than thick separated milk for the health and growth of the chickens.

Those going in for ducks should hatch according to the numbers they have to supply for eating each week. Ducks must have all the food they will eat from the time they are hatched. A quick-growing duck should put on 1 lb. per week and be ready for killing at from seven to eight weeks old. Always kill or sell for killing just before the large wing feathers commence to grow.

If the rains have stopped, turkeys can be hatched. See that the youngsters are kept warm, but also that they have plenty of fresh air. Never feed young turkeys on wet or moist food, but give dry mash, grain, plenty of onion tops or onions chopped small, and thick separated milk. Keep them free from insect vermin; they will never thrive if they are infested with these.

Never allow the hen that has hatched the turkey eggs to run with the youngsters. Always confine her in a coop, through the slats of which the young turkeys can run in and out. The coop should be moved to fresh ground each day; nothing is worse for young turkeys than to be running on the same piece of ground for long at a time. Tainted ground is one of the chief causes of mortality among young turkeys.

The Care and Maintenance of Mowing Machines.

By J. de Szabo, Agricultural Engineer, Grootfontein College of Agriculture, Middelburg, C.P.

The mowing machine plays an important rôle in farming economy in South Africa. A mower is to be found on practically every farm, and fully 90 per cent. of the total hay crop of this country is cut by these useful machines.

Comparatively simple in construction, mowing machines lend themselves to ease of maintenance, yet how often is it not the case that the mower is the most misused implement on the farm?

The effectiveness of a mower and its durability depend largely upon the degree of care bestowed on it. Disregard of the primary principles of maintenance will lead to its quick deterioration, but with proper attention the machine should give satisfactory service over a long period of years.

The following hints upon the care of mowers and the manner in which they should be used will, it is hoped, prolong the life and efficacy of many a machine.

Before Use.—1. Before it is sent out to the field, the whole machine should be examined very carefully, particular attention being paid to the following parts:—

(*a*) Bolts, nuts, screws, and joints: Loose nuts should be tightened and special attention directed to the cutting mechanism, the inner and the outer shoes, the pitman rod and pitman wheel, and to the lifting levers and mechanism.

(*b*) The adjustable parts should be inspected, and set correctly if necessary.

2. All moveable parts should be well lubricated, the parts being moved or cranked to permit the oil to spread evenly over the surfaces.

3. It is essential that the centre line of the knife and the centre line of the pitman head should coincide when the machine is in use. If the pitman and the knife are not adjusted properly, friction occurs along the cutter bar. causing unnecessary wear and tear in the moving parts, and increasing the load on the draught animals.

In the factories the cutter bar is set in such a position that its outer end is about 1¼ to 1½ inches ahead of the inner end. This is due to the fact that when the machine is operating under a load, the strain pushes the cutter bar backwards into its correct position in which the centre lines of the cutter bar and of the pitman are in a straight line.

4. Every part of the machine should be clean and free from rust.

5. If lands or fields in close proximity to plantations or fences are to be mown, a preliminary strip, five to ten feet wide, should be cut by hand—a scythe or reaping hook being used—along the edge adjoining the trees or fence. This will facilitate the start of mowing operations and will reveal stumps, stones, wires or other obstacles which are frequently found near fences and plantations and which might injure the mower.

6. The height of the cut, which can be altered by adjusting the inner and outer shoes, should be set properly before work is started.

7. The knife sections and guards (fingers) must be in alignment, *i.e.*, all the centre lines of the knife sections must coincide with the centre lines of the guards when the knife is at the extreme left or right of its stroke. If the knives and guards are out of alignment, the mower will not work satisfactorily and the cutter bar will probably clog after a few minutes work.

During Operation.—1. The knife should be removed and re-sharpened every three to four hours.

2. If grass, lucerne or other mown material jams between the knife and the ledger plates, or guards, that indicates that the knife is not sharp enough, that the knife holders are too loose, or that the cutter bar is worn out. The knife must be

flush with the ledger plates, otherwise the machine will not mow satisfactorily, and the cutter bar will be thrown out of alignment.

3. In order to obviate unnecessary wear of the moving parts of the machine, the clutch should be engaged only when the machine is in operation, but it is advisable to put the knife into gear shortly before the cutter bar is lowered. As soon as the work is completed, the cutter bar should first be raised and then the clutch disengaged. If the mower is drawn along the field with the clutch disengaged and the cutter bar lowered, dirt and debris collected by the cutter bar may easily clog its mechanism.

4. If any obstacles such as ant-heaps or stones are encountered, the cutter bar must be raised with the foot lever, and the operator should therefore keep his right foot on the lever in order that he might act quickly. When turning, the cutter bar must be raised, but the cutting mechanism should be left in gear.

5. Since the cutting apparatus will work on slight bends, it is not necessary to lift the cutter bar from the ground in such cases.

6. The cutter bar is usually placed to the right of the mowing machine. With such mowers the operator *must always turn to the right when working.* In some machines, however, the cutter bar is on the left, and in such cases left-hand turns only must be made. *But when turning back, which is done with lifted cutter bar, the operator must always turn to the opposite side of the cutter bar,* e.g., *left, if the cutter bar is on the right-hand side.*

7. Mowers having two speeds are used in the lower gear when they are drawn by horses, and in the higher gear when pulled by oxen.

8. *It is very important not to race when mowing.* Mowing machines are not designed to be drawn at a speed greater than 2½ miles per hour, which is the average walking speed of a horse. If the horses are driven at a faster rate, additional frictional losses occur in the mechanism of the mowing machine, and the increased burden fatigues the horses. More-

over, if the operator mows in too great a hurry, he often fails to see obstructions or does not lift the cutter bar quickly enough, with the inevitable result that breakages occur in the gears, the most expensive parts of the machine.

After the Daily Work.—1. The cutter bar should be lifted and properly fixed before the mower is drawn back from the field.

2. The knife should be removed from the machine, be properly cleaned, sharpened, and refitted after being oiled slightly. The cutter bar and the guards should also be cleaned. If rain has fallen during operations, or if a damp field has been mown, moisture should be removed from all parts of the mower and the movable parts oiled.

3. Loose screws, bolts and nuts should be tightened, and any defects repaired.

4. The points of the guards should be examined, and bent points hammered back into position with light blows.

5. One or two knives should be kept as spares.

6. The mower should be stored in a clean and properly covered shed, and should be kept as free from dust as possible.

If these points are carefully observed, good results will follow. Lack of care of the mower, however, will reduce its life and impair its utility, and more often than not, friction resulting from maladjustments or unlubricated surfaces will increase considerably the burden on draught animals.—*Farming in South Africa*, February, 1940.

Contour Planting and Terracing of Orchards.

By D. AYLEN and the Irrigation Department.

GENERAL.

Conservation of soil and water are two of the most important factors in the successful production of fruit, and the quality of the fruit is also dependent on the amount of humus available.

Contour planting and the terracing of new orchards can facilitate the attachment of these three desirable factors.

The planting and gradual terracing of an orchard can be effected in such a way that little extra labour is involved, and the subsequent working of the orchard is no more difficult than in a square planted one, and erosion and runoff of rain-water can be reduced to negligible proportions. On established orchards the construction of soil conservation works often involves the removal of a few trees, but it has been found that the increased yields from the remainder more than compensates for this. The limiting factor for the successful cultivation or orchards in many parts of Rhodesia is moisture, and the more rainfall that can be retained in the soil for utilisation by the trees during the dry season the better.

If the orchard is contour ridged the absorption of water by the soil can be improved by the excavation of pits at intervals behind the ridges, and filling them with weeds and trash, or alternatively by the construction of low banks at intervals at right angles to the contour ridges, but naturally the top of these banks which are level must be considerably below the top of the contour ridges themselves.

While these measures will retard the runoff of storm water, they will be of little value unless the moisture retaining capacity of the soil itself, which is almost entirely dependent on the amount of humus present, is improved.

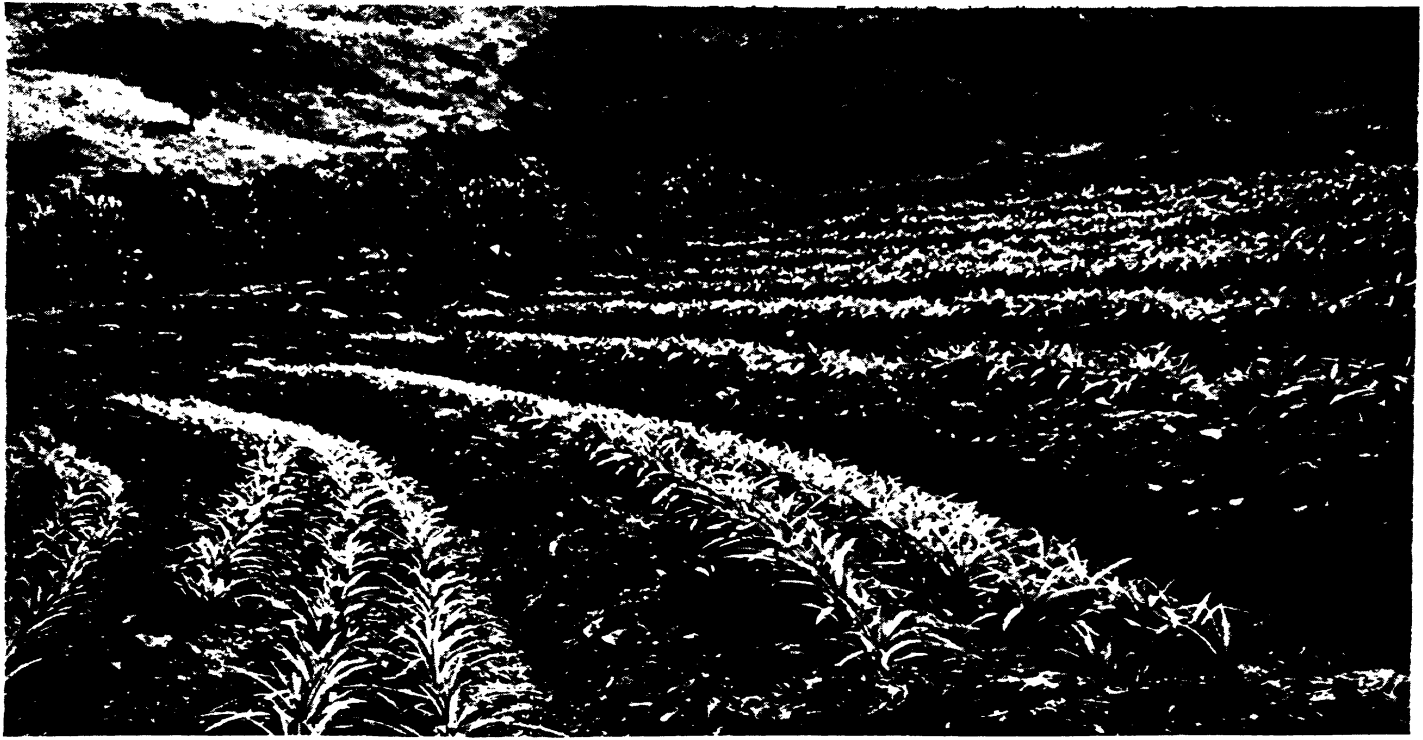


Fig. 1. Bench Terraces, Umtali.

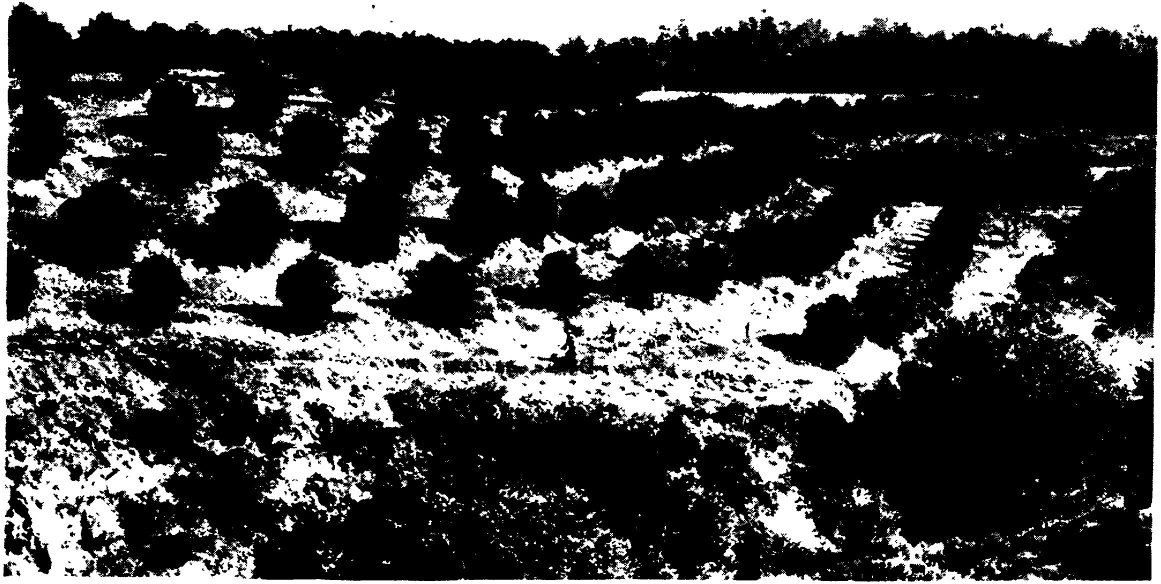


Fig. 3. Nine-year-old orange grove in California. Contour planted on a steep slope and gradually terraced by ploughing. (Courtesy U.S. Soil Conservation Service).

Repeated cultivation will damage the soil structure if the humus content is low, and scraping with hoes will have the effect of creating an impervious surface layer which not only reduces the rate of penetration of water, but also prevents the access of air to the roots of the trees, and is therefore harmful.

Instead of clean cultivation it is preferable to allow weeds to grow, and to control them by cutting and slashing. The disadvantages, however, are that the weeds utilise much moisture and may also harbour pests. The best system of all is the spreading of mulch between the trees. The usual rate of application varies from 3 to 6 tons per acre dependent upon the size of the trees, but even heavier applications have been used with added benefits.

A suitable mulch crop can be grown on the vacant strip of land between the rows of trees. The advantages of a mulch are that it immediately increases the rate of penetration of rainwater, and also reduces evaporation.

The reduced rate of evaporation directly causes an improvement in the soil structure, later the gradual decay of the mulch forms humus which renders the soil still more friable and retentive of moisture.

Leguminous crops are to be preferred for the mulch as they supply much-needed nitrogen, and sunnhemp if cut before it is high enough to choke the trees is excellent. Sunflowers, munga, Sudan grass or other heavy yielding crops are also quite suitable. Considerable damage can be done to trees, especially when young, if the intercrop is planted close to the trees or allowed to grow so high that it competes with the trees for light and air. It is for this reason that a wider spacing between the rows is recommended, and even then the intercrop, if a tall variety, should be restricted to a narrow strip midway between the trees. In order to prevent the risk of damage by fire, fireguards should be made round the orchard and breaks left in the mulch at intervals. It should be realised that orchards should be given the same consideration as regards feeding the soil as any other crop that is expected to do well.

Trees are unlikely to continue to produce good yields if the soil is not fed and is allowed to erode.

METHODS OF SOIL CONSERVATION IN ORCHARDS.

There are four different methods of effecting soil conservation in orchards, *viz.*:—

(1) *Bench Terraces* constructed prior to the planting of trees. As this method is relatively costly it is mainly confined to small home orchards and gardens on the slopes of kopjes. Details of construction are given later.

(2) *The evolution of specially designed contour ridges to form bench terraces.*—This is the most satisfactory method to adopt for the planting of orchards on any large scale, and full details of this method are given later.

(3) *Normal type contour ridges.*—On relatively flat slopes the ordinary type of contour ridge with normal spacing can be constructed and the trees planted in rows on the contour between the ridges either accurately on the contour or in rows parallel to one ridge, or the trees may even be square planted if so desired. However, square planting is only to be recommended on the gentlest of slopes.

(4) *Contour planting* of trees with strips of permanent cover between the rows. The most satisfactory cover for this purpose is paspalum dilatatum. No detailed description of these two last methods is necessary.

CONSTRUCTION OF BENCH TERRACES.

In the case of bench terraces, the object is to set out the work so that the amount of soil excavated will be sufficient to fill the lower half of the strip and form a practically level terrace of reasonable width.

The width of the terrace will therefore be defined by the slope and the depth of soil available for excavation, and as a general rule it may be accepted that the depth of excavation should not exceed a maximum of 2 feet, and the width of terrace should not be less than about 20 feet, unless small types of trees are being grown.

This in effect means that this method of construction is not advised on slopes steeper than 1 in 5. Further, as the method is costly it is obvious that it is not economical for large areas, and is really only suitable for small orchards in cases where the slope is steep but fairly regular over the whole area.

Having cleared the area, a line is set out down the slope at right angles to the general contour of the hill and pegs put in, making the width of each strip so that the depth of excavation at the upper peg in each strip will be equal to the amount of filling required at the lower peg.

Lines are then run out along the contour, *i.e.*, approximately at right angles to the base line, from each peg and pegs placed at suitable intervals to define the extent of each strip.

If the terrace, however, is to be irrigated, these pegs will not be placed on the level contour, but will have a falling grade of 1 in 200 as a maximum. The excavation of the lowest terrace is commenced first, and if necessary the top soil is retained for spreading over the surface of the uppermost terrace. Fig. No. 2.

If the slope is a steep one and boulders are readily available from the excavation or elsewhere, they can be utilised for protecting the face of the terrace and for holding the filled soil at a steeper slope than its normal angle of repose.

In these cases this wall is carefully built up as the filling proceeds and should be at least 9 inches in width with a foundation footing 18 inches in width, and the face sloped back at a slope not steeper than ½ to 1, i.e., 1 foot for a 2 foot depth of filling. In some cases brick walls are constructed, but in that event weepholes must be left at intervals. If, however, boulders are not readily available and the slope is not unduly steep, the filled material may be allowed to set at its natural angle of repose, which is usually about 1½ to 1, i.e., a slope of 18 inches for every foot of filling, and the bank is protected by being planted to grass or other permanent cover, paspalum dilatatum being excellent for this purpose. Pelargonium ("Scented geranium") is also suitable. This

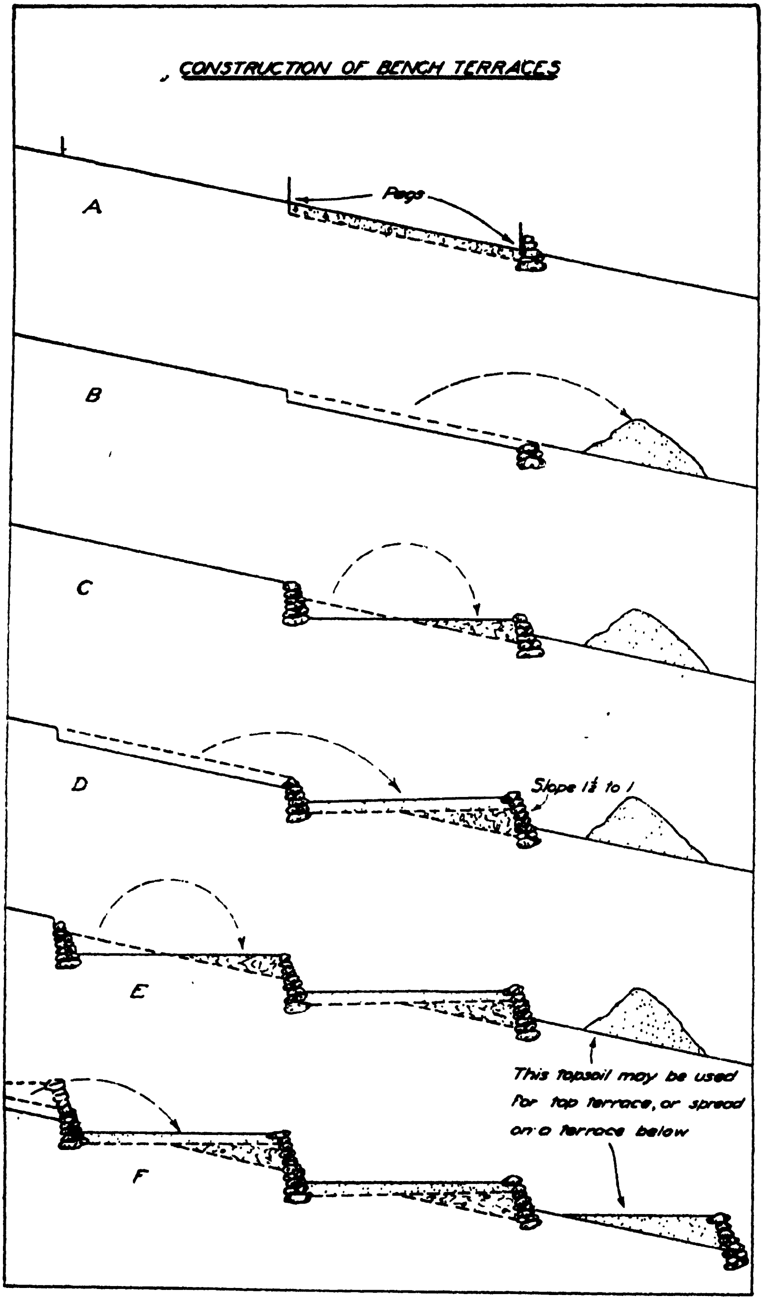

CONSTRUCTION OF BENCH TERRACES
A
Pegs
B
C
D
Slope 1½ to 1
E
F
This topsoil may be used for top terrace, or spread on a terrace below

Fig. 2.

plant binds the soil well, has a commercial use for essential oil and provides a heavy growth which may be used for compost or a mulch.

The excavated material should be spread in layers and well rammed, and be sloped back from the outer edge inwards to provide for future settlement of the material, which even if well rammed, will be at least one inch for each foot depth of fill. When the excavation and filling of one terrace is completed the top soil from the next terrace is excavated and evenly spread over the whole surface of the next lower terrace. When the terraces are completed the trees are planted in the centre of each.

CONVERSION OF CONTOUR RIDGES TO TERRACES.

On gentle slopes normal contour ridges give adequate protection, whilst on very steep slopes true bench terraces must be constructed prior to planting. The big gap in between which comprises the more prevalent degrees of slope can be successfully and cheaply protected by the conversion of contour ridges to terraces. (See fig. No. 3.)

CONSTRUCTION OF BENCH TERRACES: PROCEDURE.

A. Commence the retaining wall of the lowest terrace.

B. Remove the top-soil from the strip above.

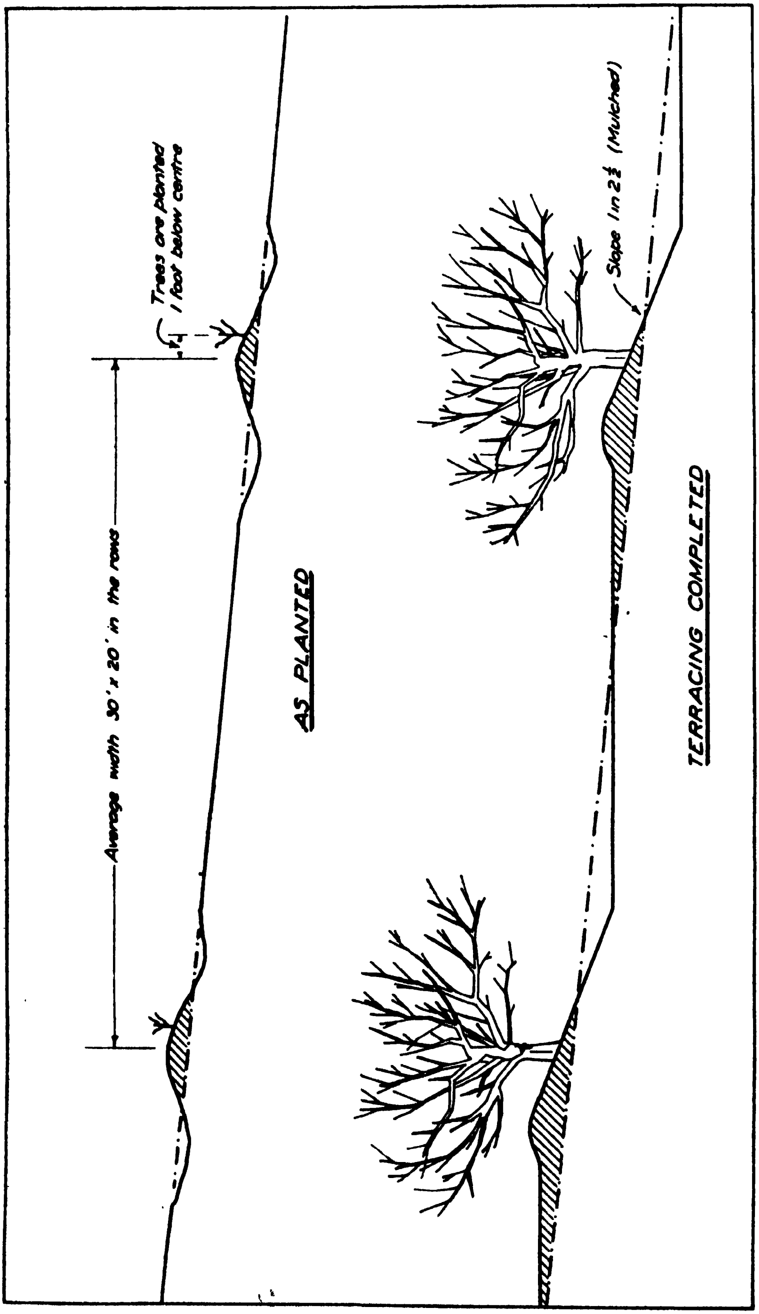
C. Level the subsoil and dig up the inside half of the strip to a depth of nine inches. Build up the retaining walls as required.

D. Remove the top-soil from the strip next above and spread evenly over the levelled subsoil.

E. and F. Repeat the process on the next strip.

Note 1.—If there is insufficient topsoil available to level the additonal terrace at the bottom levelling can be accomplished by short sections, making mounds of topsoil at intervals, levelling the subsoil, etc., and then the gaps between previously covered by the mounds.

Note 2.—At intervals a terrace should be left unplanted if required for a service roadway.


Trees are planted 1 foot below centre
Average width 30' x 20' in the rows
AS PLANTED
Slope 1 in 2½ (Mulched)
TERRACING COMPLETED

ig. 4. Conversion of Contour Ridges to Bench Terraces. First Method—Trees on Down-slope. A suitable practice for moderate to steep slopes.

If the trees are planted as described first very little additional labour after the initial construction of the ridges will be required with any degree of land slope, beyond the gradual terracing of the land by continually throwing the furrow downhill with a reversible plough, and the raising of the ridge.

The second method on slopes flatter than 1 in 20 involves no work beyond that required for the first method, but on steeper slopes considerable hand labour will be required each year.

Contour ridges on a suitable gradient are pegged out and constructed.

FIRST METHOD OF PLANTING. (See fig. No. 4).

The trees are planted on the top of these ridges at a distance of about 1 foot from the centre towards the lower side. The usual spacing adopted is 30 feet between the rows and 20 feet between the individual trees in each row.

By the use of reversible ploughs the soil is gradually brought down so that eventually a practically level bench is formed between the ridges.

Care must be exercised that the ploughs do not cut into the downslope of the contour ridge, and therefore the ploughing should be stopped short of the previous ploughing each time.

If this is done the downslope of the ridge will eventually become a continuous and not too steep bank.

If the ridges are originally constructed to a height of 2 feet, and the slope of the land is not more than 1 in 20, there will be no fear of the ridges being overtopped in heavy storms even when all the soil has been worked down to form a level terrace. If, however, the ridges are originally constructed on a lesser height, and in any event if the land is on a steeper slope, *e.g.*, 1 in 10 and the ridges have been constructed 30 feet apart, it will be necessary to raise the ridges gradually as the soil is worked down in order to prevent them being overtopped. Level ridges in every case must be constructed to a sufficient height to impound all rain

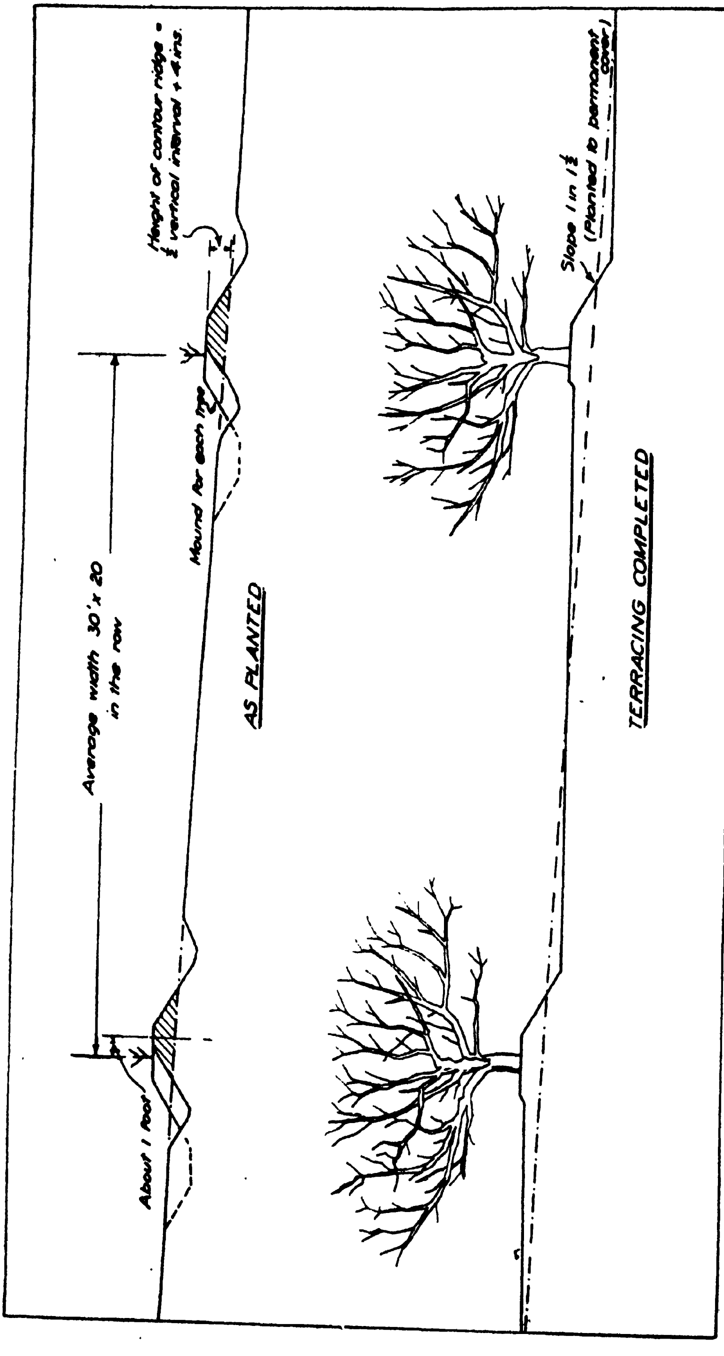

Height of contour ridge = ½ vertical interval + 4 ins.
Mound for each tree
Average width 30' x 20 in the row
About 1 foot
AS PLANTED
Slope 1 in 1½
(Planted to permanent cover)
TERRACING COMPLETED

Fig. 5. Conversion of Contour Ridges to Bench Terraces. Second Method—Trees on lip of terrace. Suitable practice for ground slopes of 1 in 20 and less.

water without overtopping; only when on a gradient is it permissible to make low ridges which will be gradually raised.

The planting of the trees on the downslope as advised will enable the ridges to be raised without the soil thus placed impinging on the stems of the trees.

The hand labour required can be reduced by judicious use of the plough, and perhaps a very light ditcher or by means of a dam scraper, but a small amount of hand work will be required close to the trees. If the soil, however, is brought close to the bank by the plough or ditcher such handwork will merely consist of raking up the soil with hoes and a daily task of several hundred yards can be easily attained.

When this method of planting was first adopted in America some doubt was felt as to the effect of piling soil over the root system on the upper side of the trees. However, no harm resulted and opinions have recently been expressed that it has even been beneficial.

SECOND METHOD OF PLANTING. (See fig. No. 5).

If, however, there is any doubt as to the suitability of this method an alternative plan can be adopted of planting the trees on mounds first, above the upper side of the contour ridge, the top of these mounds being at the level of the eventual crest of the ridge when finally raised to its full height after terracing has been effected. The mounds should be so placed that the row of trees planted on them will be just inside the line of the crest of the ridge when terracing has been completed.

If the mounds are to be constructed by hand the position and height of the base of the tree can be marked by hammering in a peg to the correct height and a fixed distance from the place where the tree is to be planted in each case.

The construction of the mounds may be obviated by doing more work on the ridge before planting rather than by stages afterwards. This necessitates the construction of a ridge to the full final height and with a level crest of at least four feet wide, and of course wide stable side slopes.

INTER CROPPING.

Whilst the trees are small a portion of the area between the rows can be utilised to grow crops, and although this may be a cash crop, it is preferable for the sake of the trees that frequent green crops should be grown and if possible they should be cut and piled under the trees.

The downslope of the ridge should, however, never be cultivated but kept under cover of either plants or a mulch.

The advantages of a mulch are many—penetration of moisture is greatly increased and evaporation reduced, and the humus formed is directly beneficial to the trees.

METHOD OF LAYOUT OF THE TREES.

It is often desired to even out the spacing between the ridges and also to plant the trees so that they form straight rows in one direction.

In the case of a small orchard of from 1 to 2 acres on an even and gentle slope, this is not difficult, as the average of the true contours can be taken and the lines of the ridges adjusted so that they are all evenly spaced. The top of the ridge must, of course, be made up considerably at the low places, and ponding will occur until silting takes place or soil is transported there.

To carry out this method on any large area or in cases where the slope is steep and/or uneven would involve considerable labour in adjusting the height of the ridges and levelling off the strips, and in addition there is a grave risk of the ridges breaking opposite the hollows.

If the orchard is located in a small sheltered valley or hollow the contours will make acute bends. In such a case the ridges may be set out in a smooth curve and the trees spaced at an even distance apart. If utilised for a home orchard where a number of different kinds of trees are to be planted, the trees can often be "evened up" by planting large kinds where the spacing is wide and the smaller ones where it is more restricted.

In a few cases the slope of the land may vary considerably from one side of an orchard to the other, and in such cases layouts as shown in fig. 6 are recommended. An extreme case has been taken with a slope varying from 1 in 10 on the extreme left to 1 in 50 on the extreme right. The pegging of the ridges is commenced on the steepest slope and continued until the width of the strip between them has doubled. At this point intermediate ridges are set out so that the width of the strip is equal to the original width, and continues until the width of the strip has again doubled, when a fresh group of ridges is started. This layout is shown on the left half of the sketch.

Each group is pegged so that the ridges in the middle approximate to the best spacing for the rows of trees, *i.e.*, normally 30 feet apart. In that case the width of strip at the start would be 20 feet and 40 feet at the end where a new group is started.

The trees in each row are planted at varying distances apart, dependent on the width of the strip, *i.e.*, 30 feet apart at the start, 20 feet apart from the middle onwards so that each tree has ample soil to draw upon.

It must be emphasised that such an extreme case is unlikely to actually occur, but in order to overcome objections that may be raised, it is necessary to show how relatively easy it is to overcome conditions and difficulties which are more severe than are likely to be experienced in the field.

If the area of the orchard is large or if otherwise considered desirable each group of ridges may be definitely terminated at the points where intermediate ridges are required and a broad grassed strip running down the hill left between each group, and which will serve both as a drainage channel and a road of access.

In this case, however, the ridges are terminated when the width of the strip has increased by about 50 per cent. Such a procedure is illustrated on the right hand side of fig. No. 6.

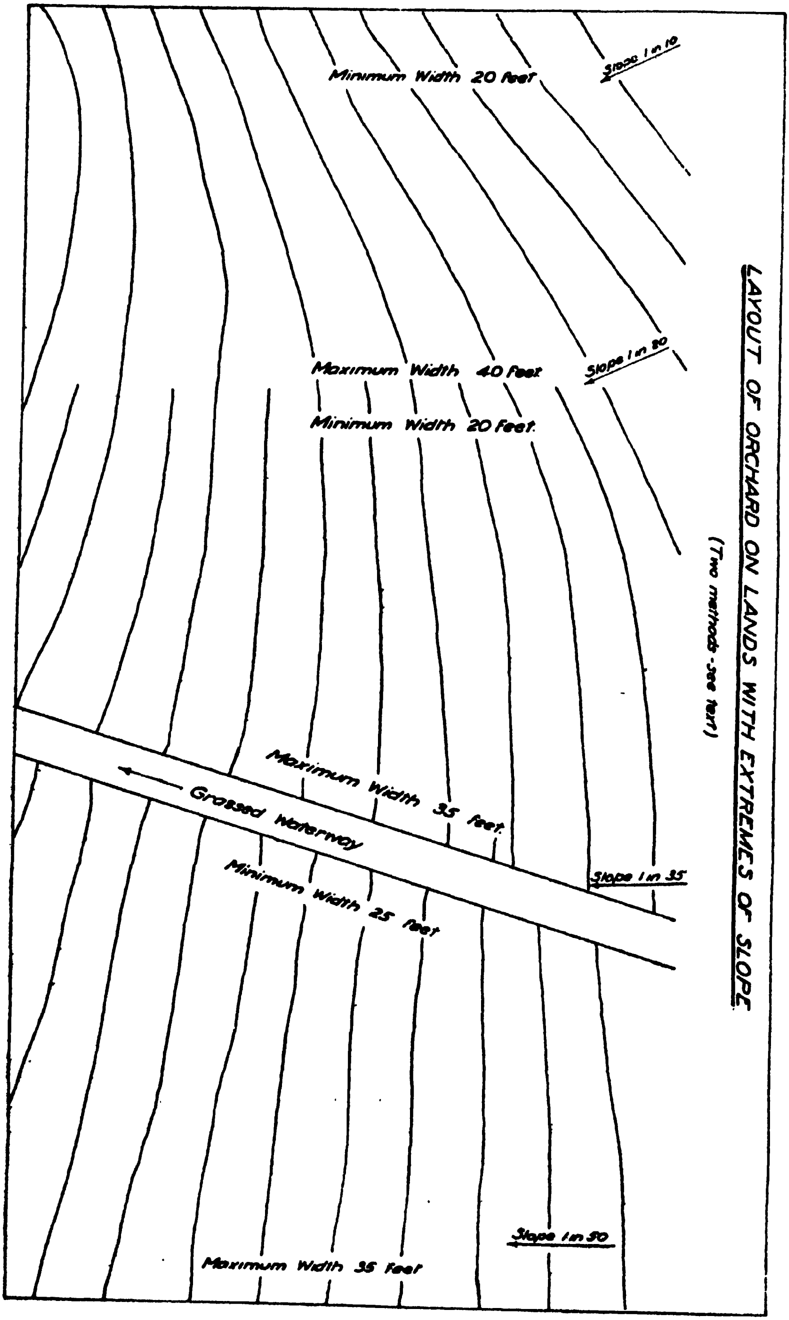

LAYOUT OF ORCHARD ON LANDS WITH EXTREMES OF SLOPE
(Two methods - see text)
Slope 1 in 10
Minimum Width 20 feet
Slope 1 in 20
Maximum Width 40 Feet
Minimum Width 20 Feet.
Maximum Width 35 feet.
Grassed Waterway
Minimum Width 25 feet
Slope 1 in 35
Slope 1 in 50
Maximum Width 35 feet

Fig. 6.

Development of Modern Composting Methods.

By Y. D. WAD, of the Institute of Plant Industry, Indore, Central India, in *Agriculture and Livestock in India*, Vol. IX., Part V., September, 1939.

The deliberate use of rotted organic wastes—vegetable and animal—for the purpose of growing larger quantities of better crops seems to be as old as the art of agriculture itself. It is conceivable that primitive man may have simultaneously (1) noticed the superiority of natural vegetation growing in virgin forest land rich in organic matter, and (2) discovered the possibility of artificial cultivation of some of the plant species suitable for his food.

At any rate, the importance of farmyard manure to crop growth has been stressed in ancient Indian and European literature on agriculture (Russell and Richards, 1917). King (1926) has described in detail how the Chinese peasants of old took elaborate care to collect all available wastes and convert them systematically into well-rotted composts. It is noteworthy that in every part of the world this system of returning its own waste material to land has maintained soil fertility in spite of continuous cropping through the ages. The crowded population of China is still being maintained on the produce of its soil after its agricultural use for over forty centuries. This is perhaps the most convincing proof of the perfect balance of ancient system of agriculture with their environment. It is very striking, indeed, that modern composting technique has very little to add to the basic principles underlying the Chinese method of making manure from agricultural wastes.

Liebig published in 1840 his essay "Chemistry in its Application to Agriculture and Physiology." This marked the beginning of a period when scientific investigations and commercial enterprise concentrated on the stimulation of crop production by means of factory-made chemical manure.

Subsequent work at Rothamsted and elsewhere established the manufacture of artificial fertilisers on a sound footing. Factories engaged during the war in the fixation of atmospheric nitrogen needed new markets afterwards. This further intensified the use of chemical manures. The use of bulky farm manures fell into the background. It was even asserted that this practice was not an essential feature of agriculture. A school of scientific workers, however, soon arose who maintained that a certain proportion of humus is essential to preserve the crumb structure in soils and that such a structure in turn was essential for efficient plant growth (Russell, 1934; Symposium on Soil Organic Matter, 1927).

Another group of scientists (Howard, 1937, 2) believed that the artificial stimulation of soil activities for commercial cropping was sure to upset the natural balance of soil factors and in the long run might lead to evils not yet fully realised. They maintain, therefore, that in any agricultural system adequate provision is absolutely necessary for returning all the waste products of agriculture back to the land. Howard (1937, 1) even maintains that in specialised systems such as the planting industries it may be necessary to make provision for the supply of humus to the soil by manufacturing it at extra cost from other sources to enable the soil to meet the abnormal strain resulting from highly intensive cultural practices.

Also, the large majority of the cultivators in the world still believe that the produce obtained by the use of chemical manures is not always equal in quality to that obtained by the use of ordinary farm manure.

Recent discoveries of workers on animal nutrition have apparently confirmed this belief by their findings (McCarrison, 1926, 1937; Viswanath and Suryanarayana, 1927; Ramiah, 1933). It has also been claimed (Howard, 1937, 1) that the use of humic manures from vegetable and animal wastes imparts disease resistance both to crops and the animals that feed on them. Recently, a fresh impetus was received by the investigations into the nature of soil humus and the decomposition of organic wastes to humus (Russell and Richards, 1917; Waksman *et al.*, 1929; Du Toit and Page, 1930, 1932; Waksman and Iyer, 1932, 1933; and others). This was accompanied by zealous attempts of other workers to discover how to make larger quantities of humic manures and how to increase the speed of the decomposition (Carbery and Finlow, 1928; Rao and Subrahmanyan, 1932, 1935; Anstead, 1932; Gadgil and Hegdekatti, 1937). These workers aimed at ensuring a copious supply of cheap and properly made humic manure.

Richards and Hutchinson (1921) artificially converted straw to humus by the help of ammonium sulphate. This led to the development of the patented "Adco" process.

Fowler (1930) and Howard concentrated their efforts on the utilisation of all available organic residues for making composts of the Chinese type. Fowler stressed that it is necessary to build up an intensively active biological starter of the proper type to ensure a good start and maintain the speed thus secured throughout the course of decomposition. His system of making "activated composts" is founded on this principle and is applicable equally to both farm residues and town wastes.

Howard aimed chiefly at making all types of residues into composts and thus increasing the supply of cheap humus. He saw in this a means to compensate for the existing shortage of cattle dung for manure-making in India where cattle dung is badly needed for fuel purposes in the absence of a satisfactory substitute. His work in this direction culminated in the development of Howard and Wad's Indore Process (1931, 1935).

This process aims at utilising the harder residues by making them less refractory to the influence of the fermenting micro-organisms by the physical cracking of tissues or by exposing them to the corrosive environment of actively decaying material of a better composition. It lays special stress on starting the heap with a physical structure capable of maintaining adequate aeration without undue loss of moisture all through the period of decay notwithstanding its compaction due to the shrinkage of the rotting mass. It is maintained that a properly made heap will very soon develop within it all the required intensity of microbiological activity by itself. All the temperature ranges and sequences of the types of micro-organisms necessary for composting will automatically appear. The process is aerobic, clean, and sanitary as well as cheap and simple. The final product always maintains the proper standard of quality.

The process, therefore, spread rapidly all over the world and is applicable to a large variety of cultural systems and environments. It can convert all types of wastes quickly into well-rotted composts. This is typically illustrated by its application (1) to the disposal of habitation wastes (Jackson and Wad, 1934; Howard, 1935, 1937, 1938), (2) the composting of cane trash (Tambe and Wad, 1935; Dymond, 1923, 1938) and of sisal wastes, the wastes of tea, coffee, rubber and cocoanut and oil palms (Bagot, 1936; Howard, 1938) and its modifications for making composts with rain water (Timson, 1937) and by the intermittent supply of water from canals (Jackson, Wad, and Panse, 1934).

Fowler (1930) seems to have considered partially anaerobic conditions during the later stages of decomposing heaps as having some beneficial effect.

The author of this note has observed that under the hot arid climate of the Rajputana desert the compost made with three turns had an inferior chemical composition than that produced by one turn only. It appeared that due to the difference degrees in the ease of fermentation of the various components of the heap the more easily decaying portions under the stimulus of local climate reached the stage of complete oxidation and consequent losses by the time the more refractory parts were sufficiently crumbled down. It is possible that losses of this nature may be kept down by lessening the number of turns or altering their intervals to regulate the ventilation to the desired degree.

While investigating the possibilities of the hot fermentation process Rajgopal *et al.* (1936) have concluded that in compost heaps a better conservation of carbon and nitrogen is possible when anaerobic conditions follow after a vigorous aerobic start with rise of temperature. The mechanism by which this is brought about is yet to be fully investigated.

Howard (1937) has recently evolved what he calls "Sheet Composting." This seems to suit wherever labour is scarce or costly. Residues of field crops are composted *in situ* in the field without collecting and removing them. The conditions in sheet composting are perhaps semi-aerobic. The following description by Howard will illustrate an application of this principle:—

This development was worked out during the last two years on the potato areas of South Lincolnshire which have been known to suffer from shortage of humus. After the pea-crop grown for canning has been harvested, the land is immediately drilled with beans. The sown area is then covered with a layer of crushed straw from the shelling machines followed by a thin layer of farmyard manure. The Indore process then sets in on the surface of the soil. The beans grow through the fermenting mass and at the end of September are ploughed in with the layer of finished compost. Decay is rapid and by the time the fields are planted in potatoes the following spring the resulting humus has been incorporated in the soil and is ready for nitrification. This modification is known as sheet composting—the making of humus in a thin layer all over the surface. Catch crops of beans or mustard or a crop of weeds can also be manured with humus or farmyard manure before ploughing-in in the autumn when sheet composting again takes place. The turf of old pastures or old leys can be converted into humus in a similar fashion. The Indore process has in this way been applied with success to no less than three important practical problems, green manuring, the effective utilisation of weeds and stubble and the better utilisation of the old turf of grass land.

Similar attempts at simplification are being made by applying waste organic matter direct to the soil with inorganic reinforcements (Eden, 1935, 1936). The present system of burying tea prunings and loppings of shade trees along with the chemical manures may also be considered a similar operation.

It appears to the author that perhaps the most economic and convenient method of returning waste material to land will be a preliminary aerobic decomposition to a suitable stage followed by direct application to the field, a few weeks before sowing time, before preparatory cultivation begins. There seems to be some scope for such a method as it involves the least deviation from current routine as well as the minimum of labour and care.

The Health of Seed Potatoes.

DEGENERATION DUE TO VIRUS DISEASES IS THE GREATEST SOURCE OF LOSS.

Journal of the Ministry of Agriculture, December, 1939.

An increase in the acreage planted with potatoes during war time, together with the need for maximum yields, should mean a considerable increase in the demand for good quality seed. There is no agricultural crop in which the *quality* of the seed counts for so much as it does with the potato. Not only is the yield lower from seed that is infected with virus diseases, often by several tons to the acre, but a proportion of the money spent on cultivation and manuring may also be regarded as largely wasted, for no stimulus will make badly infected plants respond with a good crop.

Unless care is exercised, one result of an increased demand for seed might be a general deterioration of stocks. Such a deterioration actually took place at the time of the last war, but during the intervening years a great deal has been learnt about the causes of potato degeneration, and a repetition of the state of affairs is now less likely. The problem, however, involves a continuous and heavy drain on the seed-producing districts. Anything, therefore, which the grower in the ware districts could do towards maintaining the cropping power of his new seed would make a contribution of value towards the production of maximum yields.

Degeneration and its Causes.—Before considering what steps could be taken in this direction, a very brief outline may be given of present knowledge on the subject of degeneration from the practical side. Each year more than 100,000 tons of seed potatoes are imported into England from Scotland, Northern Ireland and Eire. In some districts this seed is grown once only, as experience has shown that it pays to get fresh seed every year. Such districts, in which the spread of potato virus diseases is very rapid, are fortunately very limited in extent. Over most of the country the seed-size tubers of crops grown from Scotch or Irish seed are grown again at least once and often twice before the stock has to be discarded. In certain parts of the north of England it is possible to grow crops three, four, or even more times from fresh Scotch seed.

At the end of the last war, the real cause of the degeneration of potato stocks was known to comparatively few. Now, however, it is fairly widely recognised that degeneration is due to the rapid increase within the stocks of certain virus diseases, the more important of these being spread from plant to plant by means of aphides or green-fly.*

Potato stocks remain healthiest in districts where there is much wind during the growing season and where the climate is cool and moist, and it is usually a rare thing to find more than an odd aphid or two on potato plants growing under such conditions. Stocks degenerate most rapidly, on the other hand, in districts where the climate is warm and dry, and where there are long periods with an absence of wind in summer. Conditions such as these are favourable for the multiplication and dispersal of green fly, which, in the process of feeding, soon transmit virus from any diseased plants in the neighbourhood to many of the surrounding healthy plants. This, then, is the reason that potatoes in the farthest north are healthiest, and that as one moves southward into warmer climates where green fly are more abundant, the potatoes succumb more rapidly to disease. There is no infallible magic in the name of Scotland as far as seed potatoes are concerned. In sheltered and warm situations the virus diseases of potatoes can spread almost as quickly in Scotland as in England. And on the other hand, in the bleak, upland districts of Cumberland and Wales, or, as has recently been demonstrated, on the Devon and Cornish moors, potatoes remain healthy as well as they do in Scotland. It is all a matter of whether or not the conditions are suitable for the multiplication and spread of green fly, and Scotland and

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*The three potato virus diseases of most economic importance in England are Leaf-roll and Leaf-drop Streak (Virus Y), both spread by means of aphides, and Mosaic, spread by leaf-contact. These diseases are more fully described in Advisory Leaflets Nos. 278 (Leaf-roll) and 139.

Ireland are fortunate in having larger areas than England that are suitable for potatoes but unfavourable for the aphid transmitters of disease.

Increasing the Supply of Good Seed.—It will be seen from the above that there are two directions in which maximum yield must be sought, namely (1) in an increase in the amount of good quality seed produced in districts suitable for seed production, and (2) in doing as much as is practicable towards minimising the rate of degeneration of good seed when it reaches the ware districts.

It is obvious that an increase in the supply of good seed must come mainly from Scotland and Ireland, which have the largest areas with conditions unsuitable for the spread of green fly. It is likely, however, that in time of war the similar but smaller areas in England and Wales will also need to be more fully exploited than in normal times.

Growers in all these areas can contribute in two ways towards increasing the supplies of good quality seed. In the first place, the best stocks available should be procured for multiplication. If the grower's own stocks do not reach the standard for a TS(A) certificate he should consider the purchase and multiplication of such a stock elsewhere. It is only by retaining the best stocks in the best districts that the supply of good seed throughout the country can be increased. In the past, some of the highest quality seed has been spoilt in one year and been lost for ever by being sent to be grown in a bad district, whereas if it had been retained in a seed-producing area it would have raised the standard of seed and exercised a good effect over a long period. In the second place, all growers in the seed-producing districts should rogue their crops for disease as well as for trueness to type. It is from the diseased plants that all the trouble spreads, and the point of greatest importance in maintaining the health of a stock is early and frequent roguing out of all diseased plants. It is obvious that the better the stock that is being multiplied the less roguing will have to be done. It should be the aim of all growers in the seed-producing districts to purchase only stocks with Stock Seed or TS(A) certificates, and to keep them up to the standards for these certificates by careful roguing.

Minimising Degeneration in Ware Districts.—How much can be done towards minimising the rate of degeneration of stocks when they are brought down to the ware districts has never been properly investigated in England. At present new Scotch or Irish seed is very frequently planted in the same field as once- or even twice-grown English seed, in order to facilitate the farm rotation. This gives every chance for virus diseases present in the English seed to be carried across to the Scotch or Irish, and naturally hastens the rate of degeneration and the decline in yield of the latter.

Bryan has shown that it is possible to maintain the health of a good stock in the Ormskirk district of Lancashire for at least six years by isolating a portion for seed purposes in an oat crop and roguing it thoroughly. It is not possible to isolate very much seed by growing it in the middle of corn crops, however, and more investigations are needed in various districts on the benefits to be derived from an isolation of a hundred yards or even less, with or without roguing, but with no other disturbance of the farm routine.

A little special attention to crops from which seed is to be saved should be amply repaid by larger yields the following year. The measures recommended are (1) the growing of new Scotch or Irish seed separated as far as practicable, and by at least 50 yards, from any once-or twice-grown seed. Experience has shown that it is also advisable to have it separated from any Brassica crops (cabbage, kale, etc.), on which green fly may over-winter and multiply rapidly in spring. (2) the roguing out of diseased plants to prevent the spread of disease to neighbouring plants. An article on roguing will appear early next season. (3) Destruction of the haulm, soon after the plants have reached the peak of their growth, with sulphuric acid, or, in small crops, by cutting. This prevents much late infection of the tubers with virus diseases and may also prevent infection of the tubers with potato blight. This measure may entail a slight reduction in yield in the year it is done, but it should be more than repaid by an increased yield from the seed the following year. The same effect may be attained by early lifting of a portion of the crop, yielding the so-called "immature" seed, but more careful handling of the seed is then required.

The effectiveness of these recommendations will naturally be greatest in northern districts. If growers in Yorkshire and Lincolnshire would take a little extra trouble with their best crops they might considerably increase their sales of seed potatoes to other parts of England. In some of the southern districts there is often too much virus disease reaching the crops from outside sources to warrant expenditure on roguing.

There are two other points of first importance that should be mentioned when considering the maintenace of health of seed stocks. Where seed is chitted, proper fumigation of the chitting houses should be carried out during the winter, usually by vaporising nicotine, to prevent aphids spreading virus diseases from sprout to sprout in the chitting boxes. And when a field is planted with new Scotch seed which does not quite fill the field, it is the worst thing that can be done to complete the sowing with "any old bit" of once-grown seed, or even to fill in an old grave or clamp-site with such poor seed. The few hundredweights of extra crop obtained in these ways may be paid for by a loss of tons the following year, when the seed saved from the Scotch crop is planted. All old seed may be regarded as "infectious," and should be kept well away from new. It would be preferable to keep old clamp sites quite bare rather than to plant them with poor seed, or allow diseased ground keepers to grow on them and be a source of infection for both blight and virus diseases to a neighbouring healthy crop.

At a time when maximum yields are required of all potato growers, every care given to maintaining the health and cropping power of seed stocks should be of value. All that can be done at the present time, however, is to plan for planting the season's new Scotch or Irish seed in isolation.

Finally, one other measure worth consideration in the heavier rainfall districts in the west is the planting of cut ware potatoes obtained from seed-producing districts. As far as freedom from virus diseases is concerned, the ware-size tubers are as healthy or more so than the seed-size. Cut ware will often not succeed in the drier districts, however, nor is cutting advisable for some varieties, such as Majestic and Ally.

In the above article it has been possible to consider only one aspect of the health of seed potatoes, namely, that concerned with virus diseases. Questions such as the dipping of the seed of early varieties, at the time of digging, in formalin or organic mercurial disinfectants, to prevent dry rot or blight, the proper storing and chitting of seed potatoes, prevention of frost injury, etc., have all an important bearing on the production of healthy seed, but these subjects must be left for discussion on another occasion.

Summary.—If maximum production from the area planted with potatoes is to be attained, the following measures to maintain the health and cropping power of potato stocks should be adopted as far as practicable. These measures are recommended only for crops from which seed is to be saved for the following year, as it is on the quality of the seed that the yield so greatly depends.

Salisbury Agricultural Experiment Station.

AGRICULTURIST'S ANNUAL REPORT ON EXPERIMENTS, SEASON 1938-39.

By H. C. Arnold, Manager.

At the beginning of the season the rainfall was somewhat less than the average over a period of several years, and this resulted in uneven germination of the seed of most of the crops and patchy stands. From the middle of December onward copious and continuous rains were precipitated, making the total rainfall 51.33 inches, which is 22.43 inches more than the mean annual precipitation during the previous ten-year period.

Analysis of Rainfall, Season 1938-39.

Month.	No. of rain days.	Total for the month.	No. of rains over ¼ inch.	Total to end of month.	Periods exceeding one week without rain.
October...	3	1.12	1	1.72	Oct. 21st to Nov. 6th.
November	8	1.69	2	2.81	Nov. 16th to 29th.
December	19	14.33	15	17.14	Nil.
January...	22	7.86	9	25.00	Jan. 16th to 25th.
February	24	15.69	17	40.69	Nil.
March...	19	9.88	10	50.57	Mar 19th to Apr 3rd
April...	5	.76	1	51.33	Apr. 12th to 30th.
Totals...	100	51.33	55		
Average for the previous 10 years	73	28.9	35.6		

In reference to the information given in the last column of the above tabulation, it should be noted that isolated precipitations of less than .10 of an inch have been considered ineffective and have not been taken into account. Actually from time to time the rains commenced on October 20th, 1938, until the close of the rainy season on April 11th, 1939; there were no periods exceeding seven consecutive days which were entirely rainless.

The results of experiments conducted at this Station since 1919-20 are available in Bulletin form, and to facilitate comparison this report is drawn up on lines similar to previous ones.

CROP ROTATION EXPERIMENTS.
FIRST SERIES 1913-1939.

Maize Yields in Bags per Acre.

System of Cropping.	1938-39 Rainfall 51.33	1937-38 Rainfall 29.47	1936-37 Rainfall 32.68	1935-36 Rainfall 24.01	1934-35 Rainfall 31.07	1933-34 Rainfall 31.54	1932-33 Rainfall 27.64	Average Yield.
*A1—Maize continuous. Green manure and 250 lbs. per acre of phosphatic fertiliser in the seasons 1928-29, 1932-33 & 1935-36	Green manure ploughed under.	10.53	16.10	Green manure ploughed under.	4.99	19.04	Green manure ploughed under.	12.68 (7 crops)
*A2—Maize continuous. Fertiliser only, rates as above.	2.33	5.49	9.10	6.12	2.01	8.74	3.53	6.26 (11 crops)
†B—Alternate maize and beans for hay; no manure or fertiliser.	2.70	8.36	5.60	11.70	4.45	6.60	2.34	8.86
C — Three-course rotation: Maize, velvet beans (reaped), oats; no manure or fertiliser.	8.07	9.83	5.80	13.25	5.82	10.75	4.90	12.75
D — Four-course rotation: Maize (plus 6 tons dung per acre), oats, bean hay, maize. Average of two plots.	5.74	11.69	14.30	14.82	6.81	14.70	14.21	(23 years)
Maize (no manure direct).	6.19	9.78	14.70	16.63	6.82	11.90	14.40	16.08
Maize (dunged plots).	5.28	13.60	13.90	13.00	6.80	17.50	14.02	15.93

*NOTE.—Having grown maize for 15 years in succession without manure or fertiliser, during which time its yields had gradually decreased until they had become so low as under practical field conditions to have rendered them negligible, this plot had served its purpose. With the object of comparing two methods of again raising the cropping power of such land to a more profitable standard, the whole plot was treated with a mixture of one-third bone meal and two-thirds superphosphate at the rate of 250 lbs. per acre, at the beginning of 1928-29. One-half of the plot was then planted to maize while the other half was sown to a mixture of sunnhemp and velvet beans, which were subsequently ploughed in. This manurial treatment was repeated on the respective plots during the seasons 1932-33 and 1935-36.

†In 1929-30 this system was amended from "Alternate Maize and Bare Summer Fallow" to "Alternate Maize and Beans for Hay."

System A.—During the season under review sub-plot A1. was green-manured again, and another crop of maize was taken from its counterpart A2. The yield of maize was lower than it has been for several years owing apparently to the effect of the excessive rains and the lack of humus in this soil. Although no maize was reaped on the green-manured sub-plot this season the total yield of that plot over the eleven-year period is still 20 bags per acre more than that of the other plot which has not been green-manured at all.

System B.—The yield of 2.70 bags per acre obtained on this plot this season is the lowest recorded since the change in the hay crop which precedes the maize crop was made from dolichos beans to the sturdy Soya and velvet bean mixture. When comparison between the yield of this plot is made with that in System A it must be remembered that no fertiliser or manure has been applied to this land during the twenty-six years it has been under cultivation, and only the roots of the legume and maize crops are available for maintaining its humus content. Another reason for the low yield recorded this season is the inherent infertility of this particular plot as compared with that of the adjoining plots. The effect of the treatment can be more accurately gauged from the average yield than from any particular season's crop.

System C.—The yield of maize in this rotation has been well maintained, and the beneficial effect of rotational cropping has again been demonstrated. During the season under review the crop of S.E.S. oats was the heaviest recorded for several years, owing, no doubt, to the abundant rainfall and lower average temperatures having suited the crop.

System D.—The yields recorded this season are lower than might be expected, and they seem to indicate that in the absence of periodical applications of phosphate it is impossible to continue reaping heavy crops of maize.

They are also partly attributable to the synchronisation of unfavourable climatic conditions with the cropping of plots whose natural deposit of readily available plant nutrients is nearing depletion. Similar results were recorded in the season 1934-35 from the same plots, when the rainfall was abnormally heavy during the first part of the season.

In the tabulation below the annual yields of the individual plots in these rotations for the past 19 years are shown. Those for the first few years are not included because the rotational treatment had had no effect.

CROP ROTATION EXPERIMENTS.
FIRST SERIES 1913-1939.

Maize yields in bags of 200 lbs. per acre.

	System A. Maize. Continuously	**System B.** 2 Course Rotation.		**System C.** 3 Course Rotation			**System D.** 4 Course Rotation.			
		Maize	Legume Hay	Maize.	Beans.	Oats	†Maize.	Oats.	Bean Hay.	Maize
Plot Index Letter.	A.	B.	C.	D.	E.	F.	G	H.	J.	K.
Years										
1915-1920	42.3	20.8	36.7	11.1	27.0	26.9	13.3	18.8	20.1	8.4
1921	13.0	21.5	F	21.5	W	B	B	W	†M	35.0
1922	3.8	F	13.3	B	12.8	W	11.3	B	W	†M
1923	2.4	5.1	F	O	B	15.5	†M	18.9	B	O
1924	4.2	F	12.8	12.5	O	B	O	†M	11.3	B
1925	2.3	2.1	F	B	19.5	O	B	O	†19.0	26.8
1926	7.8	F	16.3	O	B	15.5	24.4	B	O	†25.2
1927	5.3	10.2	F	16.9	O	B	†22.1	22.8	B	O
1928	1.9	F	8.2	B	12.2	O	O	†20.8	14.1	B
1929	*6.2	5.7	F	O	B	12.0	B	O	†16.7	21.4
1930	11.5	B	6.4	11.4	O	B	13.3	B	O	†18.3
1931	3.0	2.0	B	B	11.7	O	†14.9	15.0	B	O
1932	10.9	B	10.0	O	B	11.1	O	†17.9	14.8	B
1933	*3.5	2.3	B	4.9	O	B	B	O	†14.0	14.4
1934	8.7	B	6.6	B	10.8	O	11.9	B	O	†17.5
1935	2.0	4.5	B	O	B	5.8	†6.8	6.8	B	O
1936	6.1	B	11.7	13.3	O	B	O	†13.0	16.6	B
1937	*9.1	5.6	B	B	5.8	O	B	O	†13.9	14.7
1938	5.5	B	8.4	O	B	9.8	9.8	B	O	†13.6
1939	2.3	2.7	B	8.0	O	B	†5.3	6.2	B	O
Totals	151.8	82.5	130.4	99.6	99.8	96.6	133.1	140.2	140.5	195.3
Averages ...	151.8	106.5			98.7			152.3		

B = Bean hay. F = Fallow. M = Mangolds. O = Oats. W = Wheat.
*Denotes the application of 250 lbs. of phosphatic fertiliser.
†Denotes the application of 6 tons per acre of farmyard manure.

System A.—It will be seen that during the first years the "Maize continuously" plot yielded more maize than the other plots, but after the eighth year the yields fell below the economic level. Since the commencement of applying phosphates the average yield has been 6.3 bags per acre, but for the period of 7 years before that it was 3.9 bags per acre. The beneficial effect of only 70 lbs. of phosphate per acre per annum is well illustrated. The greatest benefit was obtained in the four years 1929-1932, but the differences in yield since then appear to be very largely due to seasonal effects.

System B. Plots B. and C.—At the beginning of the trials the maize crop alternated with bare fallow, but it was found that the uncropped surface was more subject to erosion than a cropped surface. It was considered that on most farms a weed fallow would be preferable to the bare surface, and in the season 1929-30 a bean-hay crop replaced the bare fallow. No manure or fertiliser has been applied to this land at any time, and when the yields of maize are compared with those in System A it will be seen that they have been well maintained and that the presence of the bean-hay crop has not depressed the maize crops, but rather the reverse. There is a wide difference between the production of the two plots B and C. The former appears to be below the normal level of fertility, while the latter seems to possess a supply of plant food which is above the normal.

System C.—At the commencement the crops planted in this rotation were maize, velvet beans and wheat, but after a few years the wheat was replaced by oats, because rust attack became more virulent as the seasons passed. In this rotation the seed is gathered from the velvet bean crop and the dry vines are ploughed under; no other manure or fertiliser has ever been applied. The average yields of the five plots B to F indicate that at the beginning of these trials there was enough fertility locked up in the soil to produce over one hundred bags of maize per acre, but when the land is required to produce more than one crop in three years the individual crops may be so small that the cost of growing them may exceed the value of the crop. The maize yields in this system indicate that the bean and oat crops remove much smaller amounts of plant nutrients from the soil than the maize crop. This experiment demonstrates that, provided the farmer can make profitable use of all the crops grown, a rotational system of cropping will be found more profitable than a single cropping system.

System D.—During the first ten years the cropping in this system was:—Maize, mangold +6 tons per acre of farmyard manure, wheat and velvet beans. It was found that neither the wheat nor the mangolds were suitable summer crops for this Colony, and these were replaced by oats and maize. Hence, commencing in the season 1924-25, two crops of maize were included in this rotation instead of only one, and one of these receives a dressing of six tons of farmyard manure per acre. Compared with System A less than half the number of maize crops have been grown on this land, but the average of the total yields of these plots is as high as the total for the plot which has carried maize every year. The farmyard manure has had a beneficial effect, but judging by the yields, which appear to have dwindled somewhat during the past few years, there would seem to be a lack of phosphate in this soil now.

SECOND SERIES OF CROP ROTATIONS.

These rotations were laid down in 1919-20 and were designed to evolve a system of cropping which would meet the needs of farmers who could not adopt mixed farming. The series includes two plots, A and F, on which maize is grown continuously, excepting that during the season under review on one half of plot A a green manure crop was grown. The top growth of this was composted and returned again to the same plot in order to ascertain the effect of a humus dressing on land which has been continuously cropped to maize for twenty years. On plot F, commencing season 1929-30, phosphatic fertiliser is applied in alternate years. The fertiliser treatment given to this plot is the same in quantity and quality as that accorded in rotational System H, but green-manuring is entirely omitted.

Plot A: System E.—Maize continuous without manure or fertiliser.

Seasons and Yields of Maize in Bags per Acre.

1938-39.	1937-38	1936-37.	1935-36.	1934-35.	1933-34.	1932-33.	Average over 20 years.
3.63	3.89	3.80	6.88	2.21	4.60	1.74	8.75

When the unfavourableness of the season is remembered the yield recorded for this season is seen to be comparatively high; though, of course, in practice, the cultivation of land whose cropping ability stands at such a low level would not be profitable.

Plots B to E: System F.—Three-quarters of the land under maize, one quarter under Sudan grass. Each year one section under maize, commencing with Plot B in 1919-20, receives eight tons of farm manure per acre, and commencing on Plot E in 1929-30, the section which grew Sudan grass the previous season receives 200 lbs. per acre of superphosphate (19 per cent. P_2O_5).

Maize Yields in Bags per Acre.

	1938-39	1937-38	1936-37	1935-36	1934-35	1933-34	1919-20	Average 1920-39
Plot B ...	6.45†	Sudan	11.50	19.55*	7.19†	Sudan	26.0	16.06
Plot C ...	Sudan	11.74	14.75*	15.93†	Sudan	15.45	23.7	15.09
Plot D ...	7.25	12.64*	15.25†	Sudan	6.05	18.80*	Sudan	14.96
Plot E ...	9.45*	10.69†	Sudan	16.68	6.99*	17.73†	24.6	15.19
Average...	7.81	11.69	13.83	17.39	6.74	17.33	24.7	15.32

*Indicates the application of farmyard manure.
†Indicates the application of 200 lbs. per acre superphosphate.

The depressing influence of the climatic conditions which prevailed this season is shown in the maize yields recorded, which are the lowest for four years. The plot which received phosphatic fertiliser gave the lowest yield and thus behaved in the same way as many other plots on the Station during the season under review. This is probably because the wet and cold state of the soil prevented the soil micro-organisms from performing their normal function of fixing the free nitrogen of the air, and because of the absence of this nitrogen the plants were unable to make use of the phosphate supplied to them. This theory is supported by the fact that the plot which received farmyard manure gave the heaviest yield.

Plot F: System G.—Maize continuous. No manure or fertiliser during the first ten years. Commencing season 1929-30, fertiliser similar in kind and in quantity to that provided in System H has been applied to this plot.

Seasons and Yields of Maize in Bags per Acre.

1938-39.	1937-38.	1936-37.	1935-36.	1934-35.	1933-34.	1919-20.	Average over 20 years.
3.93	7.79*	6.65	15.26*	3.70	14.55*	23.3	10.74

*Indicates the application of 200 lbs. per acre fertiliser.

The conclusions previously arrived at in regard to the effect of a lack of humus in the soil are further supported by the low return from this plot. Its yield is little higher than that of System E where no fertiliser has ever been applied.

Plots G to K: System H.—Three-quarters of the land under maize, one-quarter under velvet beans, which are ploughed under for green manure. From the commencement of this experiment until 1928-29 this land received one green manuring and one application of fertiliser during each period of four years. The returns from these plots showed that insufficient plant food had been supplied to maintain fertility, and the manurial system was then amended to provide for two dressings of fertiliser during each four-year period. The crop of maize which follows the green manuring now receives 200 lbs. of 19 per cent. superphosphate per acre, which should enable it to make the best use of the nitrogen supplied by the green manure; the second maize crop receives no fertiliser, and the third crop, that immediately in front of the green crop, receives 200 lbs. per acre of a mixture of bone meal and superphosphate.

Maize Yields in Bags per Acre.

	1938-39	1937-38	1936-37	1935-36	1934-35	1919-20	Average 1920-39
Plot G... ...	14.23*	Beans	11.20*	14.78	14.58*	23 10*	14.49
Plot H ...	G.M.	8.40*	9.90	20.28*	Beans	23.00	14.99
Plot J... ...	3.79*	9.86	20.56*	Beans	4.34	Beans	13.07
Plot K ...	4.58	18.18*	Beans	15.35*	3 59	19.20	13.89
Average ...	7.53	12.15	13.89	16.80	7.50	21.70	14.11

*Denotes application of fertiliser.

The beneficial effect of the green-manuring is very striking. The maize yield is seen to be nearly four times as much as it is on the plot which received phosphatic fertiliser only, and three times as great as that of the plot which carried its second crop of maize after being green-manured. The production of this green-manured plot is also 50 per cent. greater than that of the plot in System F which received 8 tons per acre of farmyard manure. It is thought that the beneficial effect exerted by the green manure was partly due to the presence of humus and of the unrotted organic material in the soil, whose effect was to assist the surplus moisture to drain to the lower strata more quickly. This assisted the entry into the soil of air, which is so essential to the micro-organic life of the soil, and thus off-set the harmful effects of the excessive moisture and low temperatures. The yields of the remaining plots in this rotation are disappointing. On Plot J, which carried the third crop after green-manuring, in spite of the application of 200 lbs. of fertiliser, the yield was little better than that obtained in System E, where no fertiliser or green-manure has ever been applied. In System G, where no fertiliser was applied this season, and no green-manure has ever been applied, the yield was as high as that on Plot J. It appears, therefore, that the beneficial effect which is conferred by a green-manure crop does not persist for more than two years under the conditions pertaining to this experiment.

THIRD SERIES OF CROP ROTATIONS.

In the season 1926-27 two more rotational systems were laid down, which have been designated Systems M and O respectively.

System M.—This is a four-course rotation in which the sequence of the crops is:—Maize+200 lbs. per acre of superphosphate; ground nuts and sunflowers; maize+200 lbs. per acre of bone and superphosphate; green manure. Hence one-half of the land is sown to maize, one-eighth to sunflowers and another eighth to ground nuts, and one-quarter is green-manured. In the following tabulation the yields of the various plots are expressed in bags per acre, a "bag" of maize being 200 lbs., and a "bag" of ground nuts 65 lbs.

	1938-39	1937-38	1935-36	1934-35	1933-34	1932-33	1926-7	Average maize yield 1926-39
Plot A... ...	G.M.	9.66*	N14.3	14.90*	G.M.	13.75*	G.M.	12.55
Plot B... ...	6.75*	N.17.9	15.72*	G.M.	5.55*	N14.30	15.15*	11.01
Plot C... ...	N8.0	11.48*	G.M.	12.50*	N8.8	12.60	N21.0	13.10
Plot D... ...	9.54*	G.M.	14.88*	N15.70	7.95*	G.M.	12.06	11.43
Average maize yield	8.15	10.57	15.30	13.70	6.75	13.17	13.88	12.02

*Denotes the application of fertiliser.
G.M. Denotes the application of green manure.
N. Denotes the position of the ground nuts in the rotation.

The manurial treatment given in this rotation is the same as that accorded in System H. The difference is in the method of cropping.

The effect of the green-manuring is not so marked in this rotation as it is in System H, but a much better yield was reaped from the third crop after green-manuring. The average yield of these plots (B and D) is 1¼ bags less than that of similarly placed plots in System H. Whether or not any advantage is found in this system over an all-maize system would largely depend on the monetary return yielded by the ground nut or other crop included in the scheme.

System O.—The order of rotation is:—Maize fertilised with 200 lbs. per acre of bone and superphosphate; sweet potatoes; maize which receives a dressing of 8 tons per acre of farmyard manure; hay crops. This system is typical of a rotation suitable for dairymen or others who prefer to feed a large proportion of their crops to livestock. In practice it would probably be found necessary to make alterations to meet individual requirements, such as altering the proportion of maize to other crops; leaving the sweet potatoes down for two years, or reducing the amount of land under sweet potatoes, and growing pumpkins and melons instead. Whatever the details of the adopted system may be, if the principles on which this rotation is based are adhered to, similar results could be expected.

In the tabulation below are shown the acre-yields of maize in bags of 200 lbs. and of bean hay and sweet potatoes in tons.

Seasons and Yields in Bags (or Tons) per Acre.

	1938-39	1937-38	1936-37	1935-36	1934-35	1926-27	Average maize yield 1926-39
Plot F	H1.20	12.03†	P 1.02	19.32*	H 3.8	H 1.1	16.86
Plot G	7.54†	P 1.35	15.61*	H 1.4	11.58†	19.65	14.08
Plot H	P 2.7	11.73*	H 2.29	17.78†	P 5.65	P 6.1	17.15
Plot J	12.53*	H 1.32	14.85†	P 3.70	9.84*	16.45*	12.53
Average of maize plots	10.04	11.88	15.23	18.55	10.71	18.05	15.15

*Denotes the application of fertiliser.
†Denotes the application of farmyard manure.
P Denotes the position of the sweet potatoes in the rotation.
H Denotes the position of the bean hay crop.

The returns from these plots support those obtained in the other rotations. The dressing of farmyard manure has had little effect, but the phosphate combined with the residual effect of the previous legume hay crop has produced a comparatively heavy crop.

Methods of Utilising the Sunnhemp Crop for the Restoration of Soil Fertility.— These trials were commenced in the season 1935-36, when sunnhemp was sown and treated in different ways. The plots were all sown to maize in the season 1936-37 and the results were published in the *Agricultural Journal* for September, 1938. Slight amendments were made in the plan of treatments and sunnhemp was again sown in the season 1937-38, and treated in the following ways:—

(*a*) Sunnhemp for green manure ploughed under in the usual way eighteen weeks after the germination of the seed.

(*b*) Top growth of sunnhemp crop cut off eighteen weeks after germination, composted and returned again to the same plots.

(*c*) Top growth of sunnhemp cut for hay. Stubble only ploughed under during the autumn months.

(*d*) Top growth of sunnhemp cut off, composted and applied to the (*e*) plots, which carry maize instead of the green-manure crop. Stubble only of 18 weeks old crop ploughed under.

(*e*) Maize continuously; land receives application of compost made from the top growth of the green-manure crop on the (*d*) plots.

(*f*) Maize continuously without humus dressing.

The above treatments were replicated 10 times and each of the sixty plots in the experiment was divided into two; on one sub-plot of each pair phosphatic fertiliser at the rate of 200 lbs. per acre was applied. The fertiliser consisted of a mixture of equal quantities of raw rock phosphate and superphosphate. Maize was sown over all of these plots during the season under review. The heaviest crops were produced on the plots under (*a*) and (*b*) treatments, but it is thought that this land should be sown to another crop of maize before comparisons are made.

The Effect of the Date of Ploughing under of a Green Crop on the Yield of the following Maize Crop.—These experiments commenced in November, 1935, and were repeated in the 1936-37 season. In both of these series the sowings commenced in the month of November and were continued at intervals of a fortnight until January 15th. At three months after germination each of the separate sowings were ploughed under. The results of both these series were published in the *Agricultural Journal* for July, 1939. The heaviest crops were produced on the plots which were sown late, and afterwards ploughed under late in the season. These trials were repeated by sowing sunnhemp in the season 1937-38, but this time, instead of sowing it at fortnightly intervals, the whole area was sown on the same day, *viz.*, November 5th, 1937. Later the appropriate plots were ploughed under at fortnightly intervals, commencing March 1st, 1938. In this way the experiment was made to conform more closely with farm practice. The treatments were made in randomised blocks and were replicated ten times. Maize was sown over the whole of the area during the season under review.

In the following tabulation the mean yields of the ten plots under each of the various treatments are expressed in bags of 200 lbs. per acre.

Date of ploughing under	Mar. 1st.	Mar. 15th.	Mar. 29th.	April 12th.	April 26th.	May 10th.	
Maize yields. Bags per acre .	12.08	13.38	16.13	17.34	16.76	17.52	S.E. .74

This series of trials shows even more markedly than the previous ones that the full benefit of the practice will not be obtained if the green-manure crop is ploughed under before the end of March. There is seen to be a difference of 4 bags per acre between the mean yield of the plots which were ploughed under on the first of March and that of the plots where the green manure was ploughed under at the end of that month. The average yield from the land on which the sunnhemp was ploughed under between April 12th and May 10th is 17.21 bags per acre, which shows an increase of 5 bags per acre in favour of delaying the operation of ploughing under the green manure crop until the middle of April. Apparently there is little to be gained by further delay. Since much unrotted straw was still present in the soil when the maize was planted on the plots where the sunnhemp was ploughed under during April and May, and since the later date of ploughing the greater was the quantity of unrotted straw, the results of these trials indicate that it is neither necessary nor desirable that the sunnhemp crop shall be completely rotted before the planting of the following maize crop. On the other hand, they indicate that, *provided the sunnhemp is sufficiently rotted that it will not interfere with the planting of the following maize crop,* it may with profit be ploughed under as late as is practicable up to, at all events, the end of April.

Protein Production Crops.—Cattle feeding during the winter months is gaining in popularity and farmers are giving more attention to growing protein-rich crops to provide the necessary nutrients. Since the season 1935-36 trials have been conducted for the purpose of finding out which of our farm crops would be the most suitable to grow for protein production. Previous trials have been reported in the issues of this Journal during September, 1938, and July, 1939. During the season under review the trials included maize as grain; maize as silage; wintersome; sunnhemp as hay cut when eleven weeks old; sunnhemp as hay cut when 14 weeks old; velvet beans as silage; velvet beans as hay; velvet beans and sunflower grown together as silage; Soya beans as hay. All were sown on November 11th, 1938, and were reaped when they had reached the stage of maturity estimated to give the highest acre yield of protein. The yields of fodder and protein are tabulated below.

Yields in lbs. per Acre.

	Wintersome Silage.	Maize Silage.	Mature Maize Crop.		Sunnhemp. 11 weeks.	Sunnhemp. 14 weeks.	Velvet Bean Silage.	Velvet Bean Hay.	Velvet Bean and Sunflower Silage.	Soya Bean Hay.
			Grain.	Stalks.						
Fodder ...	38,522	32,984	3,626	2,214	1,658	3,138	16,284	2,904	29,950	4,588
Moisture %	75.3	75.6	10.5	8.0	6.7	6.2	78.8	7.0	76.4	6.9
Protein %	1.4	1.5	8.8	4.0	14.7	11.3	3.3	12.5	3.4	13.5
Total Protein	539	495	408		244	354	537	363	1,018	620

Analysis of the data in this experiment shows that, when comparing the amounts given for total protein, only differences exceeding 145 lbs. may be considered statistically significant. During the season under review the velvet bean and sunflower combination has produced nearly twice as much protein as any of the other crops. The Soya beans produced more protein per acre this season than in any previous season, which indicates that they can withstand wet climatic conditions better than some of the other crops. They compare well with the velvet beans for protein production, and when it is remembered that they are much easier to reap and are more palatable to farm livestock than the latter, it would appear that they should be more widely grown than they are at present; but it should be borne in mind that they require a higher level of soil fertility than velvet beans or cowpeas. Wintersome produced as much protein per acre as the velvet beans, but it needed 19 tons of this fodder for 8 tons of velvet bean silage to provide an equal weight of protein to that contained in 2 tons of Soya bean hay. The maize crop provided practically the same amount of protein, whether it was utilised as silage or in the mature state. The sunnhemp produced less protein than the other crops, but it has at least one point in its favour —it will yield a good crop when sown as late as the latter part of January. Most other crops, when sown as late in the season as this, would give a greatly reduced yield.

PLACEMENT OF FERTILISER TRIALS.

These trials were commenced in the season 1931-32. The fertiliser is applied in four different ways, namely, (1) Broadcast on the surface and harrowed in shortly before the crop is sown; (2) broadcast on the stubble of the previous crop and ploughed in; (3) placed in the holes prepared to receive the seed; (4) placed in drills with the seed to simulate the action of mechanical drills.

Each method of applying the fertiliser is replicated five times. During the seasons 1933-34 and 1936-37 the land was green-manured. In the first four seasons superphosphate at the rate of 150 lbs. per acre was used, but since the land was last green-manured raw rock phosphate has replaced the superphosphate.

The following tabulation shows the mean yields of the five plots under each treatment, expressed in bags per acre.

Yields in Bags (200 lbs.) per Acre.

	Fertiliser harrowed in.	Fertiliser ploughed in.	Fertiliser in seed hills 3'x3' apart.	Fertiliser in drills with seed.
Season 1931-32	16.46	19.72	18.04	18.06
,, 1932-33	6.02	8.00	6.66	8.30
,, 1934-35	10.50	11.08	11.30	12.12
,, 1935-36	16.00	15.18	15.72	15.66
,, 1937-38	13.10	13.78	15.60	15.70
,, 1938-39	2.66	3.54	3.50	3.58
Total of 6 crops	64.74	71.30	70.82	73.42

With the exception of one season only the yields from the plots on which the fertiliser is broadcasted and harrowed into the surface layers of the soil have been lower than those on which the other placement methods are employed. Seeing that the same amount of fertiliser is used in each case, it would be reasonable to think that the unused residue would become mixed with all the cultivated part of the soil during subsequent tillage operations. Thus a reserve would eventually accumulate which would offset any disadvantage which might be due to the current season's fertiliser dressing being placed in the surface layers only. The smaller differences between the yields of the "harrowed in" plots and the yields of the plots under the other treatments which have been recorded since the first two seasons indicate that a part of the residue is being used; but the lower yields which are almost invariably obtained indicate that a smaller proportion of the dressing of fertiliser is utilised by the crop when it is mixed with the surface layers only. All the other methods of placement described are found to be equally effective when the yields over a period of years are considered.

Comparison of the Effect of Annual Applications of Small Quantities of Farmyard Manure with that of Larger Quantities at Longer Intervals.—The supply of farmyard manure is usually very limited on farms in this Colony, and the question has arisen as to whether its beneficial effect will be greater if it is spread thinly over a large area each season, or whether yields equally as good will be obtained when it is applied in heavier dressings at less frequent intervals.

Experiments were commenced in the season 1931-32 by applying farmyard manure according to the following plan :—

(1) Three tons per acre every year.

(2) Six tons per acre very second year.

(3) Twelve tons per acre every fourth year.

This plan provides for the application of an uniform dressing of twelve tons of manure per acre over the whole series of plots during each four-year period. Maize is grown on the land each year.

In the following tabulation the yields obtained on the various plots during each period of two years are shown.

Yields of Maize in lbs. per Plot of 1/30th Acre.

	Three tons every year		Six tons every second year		Twelve tons every fourth year	
	1935-37	1937-39	1935-37	1937-39	1935-37	1937-39
	180	96	189	61	205	95
	181	72	177	58	208	92
	159	57	162	80	193	83
	174	62	166	53	193	60
	188	56	158	34	217	40
	180	67	165	46	198	57
	178	48	174	68	180	66
	166	49	157	49	203	54
	162	48	170	48	189	45
	170	107	201	84	227	90
	1,738	662	1,719	581	2,013	682
Total for period of 4 years	2,400 lbs.		2,300 lbs.		2,695 lbs.	
Bags per acre	36.00		34.50		40.43	

These results corroborate those of the previous series which were published in the *Agricultural Journal* in September, 1936.The returns show that the yields during the last two years are approximately only one-third of those of the first two-year period, irrespective of the size of the manurial dressing and the method of applying it. During the period of unfavourable weather conditions the small amounts of manure provided by this plan had little effect on the size of the crop. Conversely the 12-ton dressing had little more effect on the size of the crop during the first two favourable seasons than the 3-ton dressing, but apparently a residue was left in the soil and this was almost as effective as the small manurial dressings actually applied during the latter period.

The analysis of a sample of our kraal manure showed that each ton would supply 5.2 lbs. of phosphoric oxide, hence a 12-ton dressing would add 62.4 lbs. of this plant food to the soil. It is known that 2 lbs. of P_2O_5 is required to produce a bag of maize, so that the manure applied contains sufficient phosphatic compounds for the production of 31 bags of maize. In spite of the very low yields of the last two seasons the average yield of these plots over the four years was 6 bags per acre more than the manurial dressing provided for, showing that the natural reserves of soil phosphates were depleted to some extent. Seeing that investigations elsewhere have proved that the phosphate applied to the soil is never completely utilised by the crops, it is clearly shown that a 12-ton dressing of farmyard manure every four years does not supply sufficient phosphate to maintain the fertility of the land at an economically productive level so that either the dressing must be increased or phosphate from some other source must be applied as well.

Those farmers who cultivate large areas and have only limited quantities of farmyard manure will probably prefer to apply light dressings in order to ensure getting the most benefit from the manure available, but whether this method is more economical than that of applying large dressings less frequently will depend largely on the haulage and distribution costs.

Soya Beans.—This crop has received a good deal of attention during the past two or three decades in nearly every country where the climatic conditions appreciably resemble those of its native country—Eastern China. Since ancient times these beans have formed one of the chief foods of the Eastern races, and within the past half century an extensive export trade has been developed with European countries and America, where the beans are chiefly valued as a source of vegetable oil and animal food rich in protein. To a smaller extent Soya bean products are marketed in the form of special foods for infants and invalids, synthetic milk, as an ingredient of a patented sauce, in the manufacture of linoleum, and certain specialised parts of motor cars. According to one authority in the United States of America only 20 per cent. of the acreage sown to Soya beans in the year 1920 was harvested as seed, the remainder was utilised as pasture hay or silage. In 1920 less than one million acres were sown, but in 1938 nearly eight million acres were devoted to it. This increased popularity is mainly due to its suitability for mechanised methods of cultivation, combined with other merits such as high nutritive values and the heavy yields of the new strains, which have been developed at the Experiment Stations.

Soya beans were first grown on an experimental scale in this Colony more than twenty years ago, but the varieties available at that time were not suited to local climatic conditions and their cultivation was not generally adopted. One of the main reasons for the crop's unpopularity was that the plants ripened unevenly, and that a large proportion of the seed-pods sometimes burst open and scattered the seed before it was possible to harvest it. Since that time, however, numerous varieties have been received from various sources, and from these selections of types suitable for local cultivation have been made, but the more vigorous of these can only be used for cattle food, as their seed coats are either brown or black, whereas only those which have cream or creamy-yellow-coloured seed are considered suitable for human consumption or for oil extraction.

In view of what has taken place in the maize belts of America there is reason to believe that when the new hybrids, which are now underging their final tests at this Station, are available for distribution they will be found to be very valuable additions to our fodder crops. In the trials reported above in which the value of our most important crops as protein producers are compared, it has been shown that the Soya beans are second only to velvet beans in their ability to supply this most important nutrient. When the advantages gained through the ease with which the Soya bean hay crop can be harvested and its greater palatability are taken into account, they will probably be found to more than offset the value of the larger amount of protein produced by the velvet bean crop. The "Biltan" variety has been used in these protein trials, but we now have new hybrids which yield somewhat heavier crops and have an added advantage over the older strains in that their seed pods do not burst open until some 3 or 4 weeks after the plants have reached maturity. Although these varieties are very excellent as producers of fodder, their seed colour limits their sphere of usefulness by preventing them from being used in other ways, such as for human consumption, oil extraction and for export overseas. In future work will be confined to the varieties and strains having light-coloured seed. A number of imported varieties, strains and crosses between the varieties Herman and Otoxi, and a yellow seeded non-shatter variety are now being tested out.

In the year 1937 some ten strains of Soya beans were received from the School of Agriculture, Potchefstroom. These were included in trials with other varieties which are reputed to be suitable for human consumption, although in some cases their skin colour is brown. The Potchefstroom strain No. 35 S. 184 has proved itself to be a heavier yielder of seed than any of the other yellow-seeded kinds, though its fodder yields are considerably lighter than those of the strains recommended for hay. The Potchefstroom strain also retains its seed for three or four weeks after it has reached maturity, and for this reason it will be possible to delay harvesting the crop for two or three weeks should pressure of other work demand. A large number of selections and crosses are still under trial, some of which may prove to be superior to this strain, but with regard to seed production it is definitely better than the varieties enumerated below:—Southern, Mammoth, Biloxi, Otootan, Virginia, Sable, Jet, A.K., Ito San, Columbia, Virginia No. 2, Haberlandt, Laredo, Chinese White, Haberlandt No. 38, Chiquita, Dixie, George Washington, Goshen, Barchet, Tokio Black Eyebrow, Morse, Non-shattering Mammoth, Illini, Cayuga, Hahto, Easycook, Dunfield, Manchu, Rokuson, Cha Mama, Missouri, Yellow Emperor, and numerous others which have been received from various sources without names, and including the Potchefstroom strains Nos. 34 S 51; 35 S 100; 35 S 153; 35 S 263; 35 S 277; 35 S 281; 35 S 288; 35 S 332; 35 S 350.

Although the Potchefstroom strain yields somewhat larger quantities of grain per acre, it would not be as economical to grow for fodder production as the hay types produced at this Station. The larger size of the beans and the dwarf habit of growth make it necessary to sow 25 lbs. to 30 lbs. of seed per acre of 35 S 184, whereas the smaller seed of the other varieties make it necessary to use only 10 to 15 lbs. of seed per acre. In addition to this, the fodder types are more robust and yield larger crops of fodder.

Seed Maize Production Methods.—The production of hybrid maize for seed purposes is now practised on an extensive scale in the United States of America, and the trouble and expense involved appears to be fully justified by the increased yields obtained. The chief drawback to this method is that some ten or more years' work is necessary before any monetary reward can be obtained, but it should be added that after the preliminary period, if the work has been done well and on a wide enough scale to reveal strains compatible for crossing, the reward is certain and continuous. With a view to getting similar results in less time, several methods have been suggested. One of these has been investigated here, and although the results were entirely negative, they may be recorded in order that others may not waste time in trying it out. It was claimed for this plan that a variety of maize could be improved by "selfing" or in-breeding superior plants for one season. Part of the seed obtained was to be used for an ear-to-row test in the next season, and in the third season the remnant seed of the strains which had proved best in the ear-to-row test was to be mixed together to produce seed for the future main crop.

About 30 maize plants were selfed in the season 1933-34 and tested in alternate rows with open-pollinated stock in the following year. As a result of these tests the weakest were discarded and the remainder divided into classes A and B according to their vigour. The remnant seed of these was mixed and sown in the third season in a place where they would not be cross-pollinated by other stock to provide seed for the following year's trials. In the season 1936-37 this crossed seed was tested against the ordinary stock, over twenty replicated plots being assigned to each kind of seed. The difference in the mean yield of the rival plots was less than one-half per cent. Similar results have been obtained during the seasons 1937-38 and 1938-39, indicating that the method described does not produce superior seed maize.

This method should not be confused with that which is now being used successfully in some countries, where the maize plants are "selfed" for several generations, after which selected individuals are crossed. The crossed or "hybrid" seed thus obtained is tested in ear-to-row trials and those combinations which are found to produce the most desirable progeny are kept for crossing again the following year. Further testing in rows or small plots reveals those combinations of parentage which can be relied upon to produce a high percentage of progeny which will possess desirable characteristics such as high yield of grain, resistance to drought, resistance to disease, resistance to insect pests, and with root systems which resist attacks of fungus diseases which render the plants liable to being blown down by the wind. Work along these lines has been in progress for the past six years, and in preliminary trials crosses produced from the selfed lines indicate that useful combination capable of resisting drought and diplodia, which are able to make more efficient use of the soil nutrients, and hence produce heavier crops of grain than the ordinary stock, will be forthcoming. Furthermore, it is possible that by this means strains adapted to meet special conditions such as witchweed attack may be revealed.

Acknowledgments are made of the co-operation of the Chief Chemist and his staff, who have supplied the analyses of the fodders and kraal manure mentioned in this report, and to Mr. A. Rattray for the statistical analyses.

Rhodesia Weather Bureau.

FEBRUARY, 1940.

PRECIPITATION.

Station	Inches.	Normal.	No. of days.
Beitbridge	2.18	1.52	6
Bindura	16.13	7.12	20
Bulawayo	2.42	3.90	10
Chipinga	6.01	7.20	14
Enkeldoorn	7.49	5.51	12
Fort Victoria	2.79	4.70	8
Gwaai Siding	3.35	3.73	12
Gwanda	1.11	3.44	6
Gwelo	5.73	5.19	13
Hartley	5.37	6.71	18
Inyanga	10.43	7.52	20
Marandellas	13.89	6.91	17
Miami	8.53	6.23	19
Mount Darwin	9.41	6.74	15
Mount Nuza	16.40	9.64	23
Mtoko	11.09	5.87	13
New Year's Gift	4.80	3.85	7
Nuanetsi	0.84	2.35	7
Plumtree	3.35	4.43	9
Que Que	7.22	6.23	14
Rusape	8.84	5.32	14
Salisbury	10.62	6.43	19
Shabani	1.45	3.69	7
Sinoia	9.04	6.62	21
Sipolilo	4.89	6.66	18

Station.	Inches.	Normal.	No. of Days.
Stapleford	16.35	14.16	22
Umtali	7.99	5.90	7
Victoria Falls	11.36	5.51	17
Wankie	5.56	4.70	14
Abercorn	7.48	—	15
Broken Hill	16.05	—	22
Chinsali	12.31	—	20
Choma	9.95	—	20
Isoka	6.31	—	20
Kalomo	7.40	—	16
Kapiri Mposhi	11.41	—	22
Kasama	12.94	—	22
Kasempa	7.80	—	22
Luangwa	12.76	—	20
Livingstone	7.48	—	16
Lundazi	9.32	—	21
Lusaka	11.76	—	21
Mankoya	10.97	—	18
Mazabuka	10.38	—	17
Mkushi	7.69	—	18
Mongu	5.15	—	21
Mpika	14.48	—	23
Mporokoso	9.29	—	22
Mufulira	12.84	—	24
Namwala	9.64	—	15
Ndola	14.89	—	26
Petauke	7.50	—	18
Senanga	5.11	—	14
Sesheke	3.02	—	12
Shiwa Ngandu	10.72	—	24
Solwezi	9.12	—	15

FEBRUARY, 1940

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F.														PRESSURE MBS.			Cloud Tenths.	Sunshine hours.
		8.30 a.m.							Absolute.		No. of Days.									
		Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min. ÷ 2.	Maximum. Date.	Minimum. Date.	Max. > 85°	Max. < 70°	Min > 65°	Min. < 40°	Mean of 24 hrs.	8.30 a.m. Station Level.	8.30 a.m. 1200 gdm.	Mean of 24 hrs.		
Beitbridge	1,486	76.8	70.1	67	8.9	89.2	69.2	79.2	95:29	62:21	24	—	25	—	79.0	962.8	881.9	960.9	5.4	—
Bindura	3,700	69.3	65.8	64	4.2	79.2	63.7	71.5	84:18	60:21	—	1	—	—	—	890.2	—	—	6.7	—
Bulawayo	4,393	67.9	62.9	60	5.7	79.4	59.8	69.6	85:18	53:22	1	1	—	—	69.3	868.4	879.6	867.0	6.5	7.9
Chipinga...	3,685	69.4	65.6	64	4.6	77.0	61.8	69.4	81:18	57:22	—	—	2	—	63.7	891.3	880.8	—	5.9	—
Enkeldoorn...	4,808	67.4	62.7	60	5.4	78.4	59.6	69.0	82:18	55:22	—	1	—	—	—	856.4	879.6	—	5.0	—
Fort Victoria	3,571	71.0	65.3	63	6.9	81.7	62.0	71.9	88:18	56:21	5	1	5	—	71.2	894.3	880.3	893.0	5.0	—
Gwanda...	3,233	71.9	65.3	62	7.9	83.7	63.8	73.8	92:18	59:22	14	1	9	—	72.9	905.0	880.3	903.8	5.8	—
Gwelo	4,629	68.4	63.3	61	6.0	79.0	60.4	69.7	84:7	54:22	—	1	—	—	66.0	861.2	879.7	—	6.5	—
Hartley	3,879	69.8	65.7	63	5.0	79.7	63.0	71.4	84:28	59:24	—	1	—	—	69.9	884.2	879.6	—	6.6	—
Inyanga	5,503	67.5	61.4	57	7.0	73.8	57.0	65.4	79:18	49:22	—	—	—	—	—	—	—	—	5.9	—
Marandellas	5,453	62.7	58.9	57	3.9	73.7	57.0	65.4	78:28	52:24	—	2	—	—	63.6	—	—	—	7.0	—
Miami	4,090	68.0	65.3	64	3.2	76.3	62.7	69.5	81:28	59:28	—	—	1	—	68.2	877.3	879.3	—	8.8	—
Mt. Darwin...	3,179	70.4	66.8	65	4.5	80.0	65.4	72.7	85:29	62:23	—	—	13	—	—	—	—	—	8.0	—
Mount Nuza	6,668	57.8	57.1	57	0.6	64.3	53.2	58.8	70:18	49:22	—	28	—	—	57.8	800.2	879.1	—	8.5	—
Mtoko...	4,136	69.1	64.8	63	5.1	77.0	62.7	69.9	82:18	58:24	—	1	1	—	68.7	876.6	880.2	875.2	6.1	—
New Year's Gift ...	2,690	73.0	69.3	67	4.8	83.9	63.3	73.6	89:10	58:27	9	—	8	—	—	—	—	—	—	9.0
Nuanetsi	1,547	75.7	69.6	67	8.0	87.6	65.6	76.6	99:18	58:21	19	—	14	—	—	960.2	880.7	—	5.5	—
Que Que...	3,999	69.4	65.1	63	5.3	81.5	62.6	72.2	89:6	59:22	2	—	2	—	67.9	880.5	879.7	879.1	6.5	—
Rusape	4,648	67.5	63.1	61	5.0	77.2	59.2	68.4	86:28	53:22	1	1	—	—	67.2	—	—	—	5.2	—
Salisbury	4,831	66.6	63.1	61	4.1	76.2	60.1	68.2	80:v.	56:23	—	—	—	—	67.0	855.1	879.6	853.7	7.9	5.2
Sinoia	3,795	70.1	63.3	65	4.7	79.4	64.0	71.7	84:18	59:24	—	—	4	—	—	—	—	—	8.1	—

FEBRUARY, 1940 (continued)

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F. 8.30 a.m. Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min. ÷ 2.	Absolute. Maximum Date.	Minimum. Date.	No. of Days. Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hrs.	PRESSURE MBS. 8.30 a.m. Station Level.	1200 gdm. 8.30 a.m	Mean of 24 hrs.	Cloud Tenths.	Sunshine hours.
Stapleford	5,304	63.1	60.8	59	2.5	71.2	55.5	63.4	76:18	47:4	—	6	—	—	62.3	—	—	—	7.2	—
Umtali	3,672	70.1	65.9	64	5.2	81.9	63.2	72.6	88:5	57:4	5	1	4	—	70.5	891.4	880.6	890.1	5.5	7.9
Wankie	2,569	72.7	70.0	68	3.5	87.6	68.7	78.2	94:25	65:2	19	—	28	—	—	924.8	879.0	—	7.3	—
Abercorn	5,458	65.4	62.6	61	3.1	75.9	58.1	67.0	81:23	55:2	—	—	—	—	65.1	838.1	881.0	—	6.7	—
Broken Hill	3,911	67.5	65.4	64	2.5	78.9	62.9	70.9	84:1	58:24	—	—	—	—	68.4	883.2	879.4	—	9.1	—
Fort Jameson... ...	3,815	69.4	65.7	64	4.4	78.8	64.0	71.4	84:10	61:23	—	—	3	—	69.7	887.1	880.7	885.3	7.4	4.7
Fort Roseberry ...	3,830	68.8	65.6	64	3.9	80.4	63.3	71.8	84:17	60:24	—	—	2	—	69.6	—	—	—	—	—
Kasama	—	66.4	63.9	63	2.8	78.8	61.4	70.1	82:19	57:1	—	1	—	—	67.9	864.2	880.6	862.5	8.0	—
Kasempa...	4,500	64.6	63.8	63	0.9	78.7	60.6	68.7	82:21	56:23	—	—	—	—	—	—	—	—	—	—
Livingstone...	3,051	70.5	68.3	67	2.8	83.7	65.5	74.6	90:10	62:26	12	—	18	—	72.7	906.3	878.9	904.6	8.1	4.8
Luangwa Bridge ...	1,330	73.8	71.9	71	2.6	85.7	70.8	78.3	92:26	65:24	14	—	28	—	76.2	—	—	—	—	—
Lundazi	3,590	68.3	66.2	65	2.5	78.9	63.1	71.0	83:1	60:23	—	—	—	—	69.3	—	—	—	—	—
Lusaka	4,193	66.9	64.7	63	2.6	77.6	62.1	69.9	82:1	58:24	—	—	—	—	—	873.8	879.1	—	9.0	—
Mongu	3,481	70.9	67.8	66	3.9	82.6	66.3	74.5	89:29	62:1	5	—	21	—	73.3	895.5	878.6	874.1	6.6	—
Mpika	4,620	65.0	63.7	63	1.5	76.9	61.6	69.3	82:17	59:9	—	1	—	—	67.3	862.3	881.2	—	9.1	—
Msoro	3,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mumbwa...	3,500	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mwinilunga...	4,450	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ndola	4,190	66.5	64.7	64	2.0	78.2	62.6	70.4	84:1	61:2	—	—	—	—	68.3	874.9	879.9	—	7.9	—
Chileka	2,600	73.2	69.1	68	5.4	80.1	66.8	73.5	85:27	63·23	—	—	23	—	71.9	926.8	881.1	—	7.0	—

Rainfall in February, 1940, in Hundredths of an Inch. Telegraphic Reports.

Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	Total	Normal
1	59	37	7	...	6	...	1	40	1	59	11	2	14	8	...	...	...	76	2	...	...	...	...	...	...	...	2	...	...	325	378
2	48	6	18	...	3	...	...	7	10	9	127	150	9	1	...	...	2	14	15	...	...	...	...	...	...	...	...	...	43	462	540
3	3	5	...	...	9	15	4	26	10	5	409	137	12	9	..	...	1	34	53	1	...	...	..	...	6	...	39	...	50	828	794
4	187	75	33	...	...	...	3	53	43	27	41	42	18	46	36	50	13	...	17	1	...	...	...	...	...	3	9	...	1	698	615
5	114	5	6	79	9	2	6	3	23	54	21	1	40	20	64	88	57	27	11	21	7	2	...	...	...	...	...	16	...	676	508
6	57	23	101	30	8	1	31	17	5	1	17	21	35	53	30	26	26	19	...	...	...	...	...	...	23	4	25	...	24	627	707
7	38	86	9	5	19	2	38	33	39	86	186	138	20	42	52	78	12	...	19	...	...	...	...	...	13	7	..	2	13	937	656
8	50	102	81	49	17	7	47	50	28	36	119	94	45	78	39	89	30	8	64	30	10	...	...	5	17	16	13	...	1	1125	705
9	15	42	44	62	8	4	14	15	30	7	138	72	49	48	26	62	47	2	25	49	5	3	...	...	4	12	5	19	40	847	648
10	...	190	...	3	24	...	...	31	9	111	197	79	103	89	76	35	1	...	71	...	...	..	...	...	...	1	...	...	5	1025	611
Mean	65	44	28	27	9	2	12	24	19	40	81	57	31	32	37	42	22	23	17	11	2	1	...	...	5	4	6	5	16	662	568

Southern Rhodesia Veterinary Report.

FEBRUARY, 1940.

DISEASES.

African Coast Fever was diagnosed on the farm Wemel in the Salisbury native district.

Anthrax was diagnosed on the farm Selwood in the Mazoe native district. Mortality three dead.

TUBERCULIN TEST.

Fourteen bulls and sixteen cows and heifers were tested on importation. One animal showed a suspicious reaction and has been detained for a further test.

MALLEIN TEST.

Four horses and fifteen donkeys were tested with negative results.

IMPORTATIONS.

From Union of South Africa: Bulls 16, cows and heifers 16, horses 3, sheep 616.

From Bechuanaland Protectorate: Slaughter cattle 257, pigs 41, sheep 695.

From South West Africa: Bulls 46, cows 111.

EXPORTATIONS.

To Belgian Congo: Donkeys 15.
To Union of South Africa: Horses 1.
To Northern Rhodesia: Sheep 44.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom in Cold Storage: Beef quarters (chilled quality), 10,963; boneless beef quarters, 70; tongues, 4,475 lbs.; livers, 36,956 lbs.; hearts, 10,525 lbs.; tails, 6,498 lbs.; skirts, 1,411 lbs.; shanks, 3,017 lbs.; kidneys, 438 lbs.; cheeks, 2,029 lbs.

To Northern Rhodesia: Beef carcases, 31; mutton carcases, 26; pork carcases, 2; veal carcases, 1; offal, 2,344 lbs.

To Belgian Congo: Beef carcases, 30; offal, 250 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa: Corned beef, 15,552 lbs.; beef fat, 8,500 lbs.; beef paste, 9,945 lbs.; tongues, 540 lbs.; sausages, 2,542 lbs.

To Bechuanaland Protectorate: Corned beef, 1,860 lbs.

B. A. Myhill,
Chief Veterinary Surgeon.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than by stamps.

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Date..........................19.....

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Hay-meal for Cattle and Sheep.—According to an account given in *The Prairie Farmer* good results have been obtained by some Canadian farmers by putting hay through a hammer mill and feeding the chopped hay. It is stated that in this form it saves labour as self-feeders can be arranged and filled from chutes and that one ton of chopped hay goes as far as nearly one and three-quarter tons of loose hay.

Cost of Agricultural Implements in South Africa.—It is reported from Pretoria that the South African Board of Trade and Industries will bring out its report on the prices of agricultural implements towards the end of May. The Board, which was instructed by the Minister of Commerce and Industries, on the request of the Department of Agriculture, to carry out the investigation, is at present taking evidence from agricultural machinery merchants, co-operative societies and members of the farming community in general.

The inquiry is not an outcome of war conditions in the first place, but in the main will be based on pre-war conditions. At the same time, however, due attention will be paid to the grounds on which price increases have been made since the outbreak of war. The preliminary investigations have already been concluded by the Board.

The terms of reference, which were announced in March, are:—

(1) The determination of the usual margins between landed costs and the selling prices of agricultural implements;

(2) if such margins are found to be high, the causes of the excessive prices are to be ascertained;

(3) measures that might be taken to reduce prices; and

(4) any other matter having a bearing on implement costs and prices which may come to the Board's notice in the inquiry.

Stink-blaar. (*Datura*). **Culture and Sale of the Stink-blaar.** —The plants *Datura stramonium* and *Datura tatula* grow freely in a wild state in many parts of South Africa. The leaves of both these species, the former a white-flowered, and the latter a mauve or purple-flowered variety, of a slightly better quality, are acceptable in the trade. They are used in the manufacture of stramonium cigarettes and asthma remedies, alkaloids, hyoscine, hyoscyamine and atropine.

Manufacturers in the United Kingdom, says the Official Journal of the Department of Commerce and Industries, normally draw supplies of the leaves from the Continent, principally Hungary. It is thought that under present conditions suppliers in the Union will be afforded useful opportunities of gaining a footing in the market.

Prices obtained in the United Kingdom and the United States of America vary from 20s. to 40s. per cwt. according to quality. Factors which affect prices favourably are the absence of a large percentage of stalks and other foreign matter; and the attractive appearance of the leaves, which should be of a uniform bright green colour and not much broken.

Both *Datura stramonium* and *Datura tatula* grow wild on various types of soil, but under cultivation flourish best on rich and well-limed soils. The plants are annuals and can readily be raised from seed.

The leaves should be collected late in the summer when the plants are flowering. Curing consists merely in careful drying, which should be effected as quickly as possible either by exposing the leaves to the air in a shady place or, preferably, by placing them in an artificially heated drying room at about 100 degrees F. The leaves should be dried just sufficiently to prevent their becoming mouldy during transit.

Stramonium leaves for export are generally packed in hessian bags or bales of 56 lb. or one cwt., and not in boxes. They are admitted into the United Kingdom duty-free from South Africa and Southern Rhodesia.

Two importing firms in London are prepared to dispose of a four to five cwt. trial parcel on consignment. Their names and addresses will be furnished to inquirers on application to the Secretary for Commerce and Industries, Pretoria.

Utility Wheat in U.S.A.—The following extracts from a paper presented to the American Association of Cereal Chemists by Dr. J. H. Parker throw a light on the progress which has been made in judging wheat from the standpoint of utility in the State of Kansas. It will be noted that this is looked upon as the natural sequel to what has been done in this direction for livestock and corn (maize). This is considered to be an appropriate time to call attention to this development, as the first utility class for maize was introduced to our Shows last year at the instigation of the Agriculturist of this Department, who has arranged an additional utility class for the Bindura Show this year.

"As in the judging of corn and other crops and livestock, so, with wheat, an evolution is being witnessed from the old empirical methods to methods based on the results of experimental tests. Thus, the Babcock test tells accurately the butterfat in milk. Trap nests record the number of eggs laid by hens. Meat animals, after being judged in the show-ring, are slaughtered and the carcases judged according to amount and quality of meat. Corn is no longer judged according to "fancy" points, such as straight rows, covering of butts and tips, taper of ears, etc., but rather by its ability to yield and by the grade and viability of the grain. So with wheat, there has been a gradual trend and lately a rapid shift from eyesight judgment and the use of test weight and grade to the consideration of protein content and milling and baking qualities.

The managers of the Kansas State Fair at Hutchinson also established a quality wheat class in 1939, taking their cue from the old adage that "the proof of the pudding is in the eating thereof." The number of entries from any county was limited to three and duplicate entries of the same variety were not accepted from any county. Bushel samples were required in this class. These samples were judged according to the following score card:—

General—	
General appearance	10
Wheat protein	10
Milling—	
Flour yield	10
Flour and wheat protein	2
Flour and wheat ash	2
Flour ash	2
Physical—	
Absorption	8
Dough properties	12
Baking—	
Loaf volume per 100 grams flour	8
Loaf volume per per cent. protein per 100 grams flour	20
Grain and texture	8
Crumb colour	8
Total	100

One of the most significant features of the quality wheat classes at the Hutchinson and Chicago Shows in 1939 was the fact that the same sample of Tenmarq, grown by Clarence Fulton, of Harper, Kas., placed first in both Shows, although somewhat different baking methods and score cards were used. The Hutchinson samples were baked at Kansas State College. The Chicago samples were baked in the W. E. Long Laboratories, Chicago, and the judging was done by different committees. This agreement in placing the same sample first is a fine testimony to the accuracy of experimental milling and baking tests.

The United States is not the only country in which samples of wheat at fairs and grain shows are now being judged on a utility or quality basis. This idea has been adopted in Canada, Australia, New Zealand, Switzerland and England. Dr. F. T. Wahlen, director of the Swiss Experimental Station for Agriculture at Zurich, writes that they established a class of milling quality wheats at the Swiss National Exhibition three years ago and that this class is being continued to demonstrate the difference between the very best foreign wheats and wheats grown in Switzerland."

Host Plants of the Tobacco Aphis.

(*MYZUS PERSICAE*).

By CHAS. K. BRAIN, M.A., D.Sc.

As pointed out by Dr. J. C. F. Hopkins in his "Supplement to Diseases of Tobacco in Southern Rhodesia," Rosette Disease is transmitted by the common green-fly or aphis *Myzus persicae*. This aphis, which is commonly known as the green peach aphis in many parts of the world, has definitely been shown to be the common tobacco aphis in this country. This fact is of great importance, because it is reported by numerous tobacco growers that aphis trouble in tobacco has steadily increased during the last few seasons and has become particularly severe in certain districts, particularly Darwendale and Inyazura.

It is interesting to note that when the Chief Entomologist published his bulletin on "Tobacco Pests of Rhodesia" in 1928 aphis was not mentioned, which is evidence that it had not been reported as a pest in Southern Rhodesia at that date.

Thirty years ago, however, the Entomologist of the Transvaal reported in Bulletin 9 that aphis trouble was serious on tobacco during dry seasons. The species of aphis concerned was not stated.

Hardenberg, the Entomologist in the Transvaal, in Bulletin 41, 1913, wrote: "There is no doubt that the green peach aphis hibernates on cruciferous plants and probably on some weeds belonging to other plant families. Mr. W. Moore, of the Potchefstroom School of Agriculture, has reported it on cabbage during the winter months, while I have found it on parsnips which were growing between peach trees in a garden in Johannesburg. This garden was badly infested with green peach aphis the following season."

Up to a few years ago the aphis appeared to be restricted in this country to Turkish and late tobacco, but it has now become one of the most serious pests of Virginia tobacco, even on the early planted crops. It would therefore appear that there is at least a possibility that we are developing a strain of this insect which thrives particularly well on tobacco, although, as will be seen from the following list, this cannot be looked upon as the most usual host-plant. *Myzus persicae* is the only aphis which has been definitely determined from tobacco in this country, but it is quite possible that other species do occur on this crop and that they might also be concerned in the spread of tobacco diseases.

In order to devise suitable control measures for aphids on tobacco it is essential to know what other wild and cultivated plants they feed upon and how they are carried over from one crop to the next. *Myzus persicae* is in no way restricted to host-plants which are closely related and probably subsists on a large variety of plants during our winter months.

The following list of host plants of *Myzus persicae*, which was compiled from references from all over the world, is taken from Bulletin 393 of the University of Maine, 1938, and only plants known to occur in Southern Rhodesia, or closely related species has been extracted:—(Ferns), Marsilia; (bullrushes), Typha; (grasses), maize, barley; common yellow and purple arum lily; asparagus, hyacinth, lilies, tulips; (Crinum Lily), Cyrtanthus; gladiolus, freesia, iris; canna; willows; Polygonum (Smart-weed), rhubarb, dock; spinach, beet; Chenopodium; Amaranthus, khaki weed, Achyranthes; Bougainvillea; Mesembryanthemum; carnation, chickweed; Portulaca; asquilega, buttercup; poppy; all cabbage family, raddish, wallflower, and a large number of common weeds; Pittosporum hedge (wrongly called camphor-laurel in this country); hawthorn, peach, plum, almond, apple, rose; Bauhinia, Crotalaria, lupin, bean, pea; oxalis; geranium; nasturtium; Euphorbia weeds, castor oil plant; Abutilon, hollyhock, cotton, hibiscus; violets; prickly pear; Clarkia, Fuschia; carrot; oleander, Vinca; milkweed; convolvulus, sweet potato; phlox; heliatrope, forget-me-not; Duranta, verbena; mint, salvia, etc.; chili, stink-blaar, tomato, tobacco, Cape gooseberry, potato, Salonum, Withania somnifera; antirrhinum, foxglove, Linaria, Nemesia, Pentstemmon; Sesamum (Sim Sim); Gloxina; Justicia; Plantago (weed); cucumber, melon; Ageratum, daisy, chrysanthemum, Cineraria, sunflower, everlasting flower, lettuce, Rudbeckia, senecio, sow-thistle, dandelion.

Farming Calendar

JUNE.

FORESTRY.

Care should be taken by further ploughing of land or burning of grass that all fireguards round plantations are in good order and effective. Thinnings may be carried out where necessary. Cuttings may be taken and struck now of deciduous trees, such as the Carolina poplar. The pricking out of conifer seedlings into tins should be continued, and sowing of such seed for the coming planting season may be completed. A commencement may be made of preparation of land to be planted during the ensuing season, *e.g.*, by stumping if necessary, and ploughing where practicable.

CROPS.

Select seed from the very best of your own crops. It is always wise to keep more seed than you may need for planting. Do not shell and ride your maize to the railway unless it is fit for export or market. Provide ample dunnage for your maize stacked at the railway or on the farm. Use maize cobs; husks are almost useless for this purpose. Select pumpkin and melon seed from the best specimens. Support your agricultural show and make it a success by preparing and entering as many exhibits as you can. No one is more to blame for a poor show than the farmers themselves. Make a list of the seed requirements for next season, and where purchases must be made, place the orders early. Veld fires must be anticipated, and if not already attended to, the mowing or burning of fireguards, both boundary and internal, should be proceeded with.

STOCK.

Cattle.—Cows with autumn calves should be kept in the more sheltered paddocks. A watchful eye should be kept on all watering places in order to prevent their being fouled or stopped up. Where winter calves are required, the bulls should be kept out of the herd until the end of July at least, and, in the meantime, they should be well fed and cared for in order to fit them for their work. The three watchwords in the dairy herd should be feed, shelter and bedding from now onwards.

At this period of the year winter feeding of dairy stock should commence in real earnest. The milking cows should now be in fairly good condition, and in order to maintain a full flow of milk throughout the cold, dry months of winter, it is essential that liberal feeding be practised. As far as possible an attempt should be made to imitate summer conditions by feeding an abundance of succulent and palatable food. Maize silage, sweet potatoes, pumpkins, etc., are very useful for this purpose, but these feeds should be supplemented by dry roughage of good quality, preferably a legume hay, and a liberal allowance of mixed concentrates.

For dairy heifers, weaned calves, etc., there is possibly no better ration than one consisting of maize silage, legume hay and a small portion of mixed concentrates, and these feeds, if supplied in liberal quantities, should serve to keep the young stock in a thrifty, growing condition.

Sheep.—Continue to feed the ewes and lambs well. It is of considerable assistance against parasites. Dose again at three weekly intervals for wireworm and bankrot worm.

VEGETABLE GARDEN.

All the available space in the garden should now be thoroughly trenched and manured, the soil being well worked and loosened. Vegetables planted out for winter crops should be well and continuously cultivated, which will help to bring them along quicker and with less watering. Late-bearing tomatoes should be sheltered from the cold winds by a grass shield. Beet, radish, carrot, parsnip, turnip, onion, leek, mustard, cress and tomatoes may be planted.

VETERINARY.

Horse-sickness should be practically over now. Redwater and gall-sickness occur all the year round, but the worst time is the summer, when ticks are prevalent. Blue tongue should be very little in evidence now. Inoculation can be carried out now. Scab is a poverty winter disease.

POULTRY.

The poultry keeper must be on the look-out for sudden cold snaps, for if some precautions are not taken, the production of eggs will drop.

This is one of the poultry keeper's busiest periods, but method, cleanliness and attention to details pay him well. Do not leave anything that you can spare the time to do yourself to natives. Watch carefully your breeding birds, and on the slightest sign of one going off, take him or her away; if left, you will have infertile eggs, weak germs, weak chicks difficult to rear, and later weak and unprofitable stock. See that the male bird has all the food he requires, and give him a meal by himself twice a week, also a small piece of raw meat three times a week. Those who are using incubators should watch the temperature of the room on cold nights, for variations in temperature result in delayed and poor hatches, and often deformed chicks.

Field Selection of Seed Maize.

By Alan Rattray, Junior Agriculturist.

It is difficult to emphasise sufficiently the value of good seed in the successful production of any crop, and owing to the great importance of maize in the agriculture of this country it deserves particular attention in this respect. A good crop cannot be expected from poorly bred or diseased seed, and if this is used no matter how fertile the land or how much care is given to the crop in other respects, the resulting yield is certain to show a marked decrease. Poor seed usually means a reduced stand, whilst many plants will be either barren or produce only small ears with an inevitable decrease in yield. Such plants are most uneconomical as they will use up their share of the available plant food in the soil, whilst contributing nothing or very little towards the yield or grain. It seems safe to assume therefore that care and trouble taken in seed selection will be well repaid, and probably no other precaution which the farmer can take will yield such a high dividend. Selection of seed maize in the field is advocated as the best means of improving the seed of this country at present, and with the crop already ripening in the field, farmers should give the matter the necessary attention.

Past Practice.—The common practice in the past has been selection of ears from the dump, either by the farmer himself or by natives with white supervision. That this method has been of benefit is not doubted, as the maize grown in Rhodesia is remarkably pure in colour, and some exhibitors at our Agricultural Shows have shown ears of great uniformity in type from year to year. It falls short, however, in that the plant on which the ear was produced may not have been of the same high standard as the ear itself. It was most likely a good plant, because very seldom will a poor plant produce a good ear; but this may have been due to factors of environment, such as lack of competition due to a poor stand in the immediate vicinity, rather than to any superior hereditary character. Now that maize is shelled after only partial husking, farmers very often completely husk just sufficient to obtain seed for their own use. The usual custom is to set aside for this purpose a part of the crop which appears to be of higher average yield, and this increases the likelihood that the superiority of the ear is due to an advantage in environment.

Field Selection.—The failings of the above system can be largely overcome by field selection and the maintenance of a seed plot from year to year. In the first year primary attention should be given to the selection of seed for the following year's seed plot, and it is advisable to concentrate on this rather than to attempt to obtain sufficient for the whole farm. Pick out from the main crop the most suitable plants over as wide an area as possible. The ideal is to select uniformly from the whole crop, choosing plants which are superior to their neighbours, and not to concentrate on areas where soil fertility has resulted in growth above the average. From these plants the best ears are sown the following season in an isolated plot known as the "seed plot." This is used for two purposes—to supply the seed for the whole farm and to provide, by further selection, stock to carry on the seed plot. This plot must be of sufficient size to allow the farmer to select all the ears he requires whilst maintaining the necessary standard of excellence. Maize is naturally cross pollenated and therefore isolation is necessary to prevent as far as possible the access of undesirable foreign pollen. A distance of 600 yards to windward of any maize should be aimed at, but this can be considerably reduced if green manure or tree belts intervene. Circumstances must vary so greatly that no hard and fast rules can be laid down. The plot should be so situated that soil and other conditions correspond as nearly as possible to those under which the main crop of maize is grown.

Should the maize on the farm be from very poor stock it might be preferable to start by buying good, acclimatised seed before starting on field selection. The removal in the seed plot of the tassels of the poorer plants before they begin to shed pollen, is an additional method of maintaining and improving the general standard, and with some supervision natives should be able to do this work.

Method of Field Selection.—This will depend largely on the amount of time which can be devoted to the work. Where this is very limited, a good plan is to go through the lands when the ears are sufficiently dry to be removed from the stalks and pick them directly into bags, leaving the husking until such time as is convenient. Should more time be available, the crop can be gone through twice, on the first visit marking selected plants with pieces of material prominently tied round the stalk or in some other manner, and on the second reaping those which are still considered of a high enough standard. The earlier visit allows particular attention to be paid to the condition of the foliage whilst it is still fairly green, and on the latter, points such as the covering of the ear at the tip and firm anchorage of the stem, can be estimated more accurately. It is likely that many of the ears selected in the field in the above manner will prove unsatisfactory when husked, but experience should enable the proportion of ears which have to be rejected to be reduced to a minimum. Where ears have been chosen from both good and poor areas, it is advisable to keep the two classes separate, otherwise the tendency would be to discard a greater number from the poorer land owing to their smaller size. To obviate this, the final selection of ears could be done in the field when comparison can be made with neighbouring plants.

Points to be observed in Field Selection.—

1. General vigour of the plant.
2. The Stem. It should be straight and of sufficient circumference and strength to bear a large ear. Excessively tall and thick plants are often late maturing and to that extent are not desirable. Red or purple discolouration is undesirable as it may be associated with disease.
3. The plant should be anchored firmly in the ground.
4. Leafiness of plant. Starch formation cannot reach a maximum if there is insufficient leaf surface.
5. Freedom from Suckers. Where grain production is the aim, suckers, unless they contribute an ear, are only a strain on the plant.

6. Number of Ears. The varieties common in this country seldom produce more than one ear per plant, unless they are growing in particularly fertile soil. Two or more ears is no disadvantage, but one good ear on every plant is sufficient to obtain a very high yield.

7. Position of Ear on the Stem. If the ear is too high reaping will be difficult and the plant will be top-heavy. Half way up the stem, or slightly lower, is ideal.

8. The shank of the ear should be of moderate length and should curve downwards when ripe. This will allow late rains to run off rather than to set up damp conditions suitable for fungus infection. It should be free of disease and break cleanly.

9. The apex of the ear should be firmly covered by the husk. An open or loosely covered tip admits weevil and fungus spores.

10. Freedom from disease. This is desirable in all parts of the plant. The ears should be heavy, well filled, of good length and medium diameter and free from disease. Grain should be plump and bright, with medium-smooth indentation and well developed germs.

Hybrid Maize.—In the United States of America, the chief maize producing country in the world, hybrid seed is being used to an increasing extent. It has been found that good hybrid strains are more able to resist both drought and disease, show more uniformity, are more vigorous, less liable to be laid by wind and rain, and, most important of all, yield as much as 10 or 20 per cent. more than the open pollinated varieties which they have superceded. With so much in its favour it seems possible that hybrid maize may eventually become popular in this country, and early work on the Salisbury Experimental Station encourages this view. Some considerable time must elapse, however, before this comes about and suitable strains are produced.

Briefly, the stages in the production of hybrid maize are as follows:—

1. The breeding of suitable inbred strains by self-pollinating plants which show the desired characters. This

must be carried on for about six or seven generations, discarding meanwhile those strains which are found to be unsatisfactory and re-selecting only the best plants. Inbreeding intensifies both good and bad characters, thus making selection easier.

2. Crossing the best inbred strains to see which of these show good combining ability, and discarding those which do not.

3. Testing the better hybrids against open-pollinated varieties to make certain they are superior yielders. Such trials have to be thorough and carried on for more than one season, and under as varied conditions as possible. Only a small proportion of hybrids made in this way will prove to be superior to the open pollinated strains from which they have arisen; and it is possible to breed strains suitable to certain conditions.

It seems likely that the greatest chance of success in this country lies in breeding from varieties which have proved satisfactory under local conditions. Introduced varieties have been disappointing; those which are earlier maturing often suffer badly from disease. The fact that the greater part of the maize produced in the United States is yellow prevents any importation of inbred strains on a large scale with the idea of saving several years of work, apart from the fact that such strains would very probably not prove successful under our conditions. Seed which has been carefully selected in the field, and subsequently in the seed plot, should be ideal stock from which to produce inbred strains. Farmers can feel confident therefore that their work will be of lasting benefit should hybrid maize become as popular in this country as in the United States.

Diseases of Fruit, Flowers and Vegetables in S. Rhodesia.

1.—COMMON DISEASES OF APPLES AND THEIR CONTROL.

(*Revised.*)

By J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., and Aline L. Bacon, B.Sc., Division of Plant Pathology.

An article on common diseases of apples in Southern Rhodesia was published in this Journal in June, 1938(¹), but as the Bulletins are now out of print, these notes are being reprinted together with further information obtained in the past three years. Notable additions are crown gall and "little leaf," whilst the spray schedule has been revised as a result of experimental work.

General Considerations.—Observations in field and storage show that

(1) The full significance of the microscopic fungus as the occasioner of disease does not appear to be grasped by the majority of apple growers.

(2) Nearly all apple orchards carry a considerable amount of dead wood.

(3) Insufficient attempt is being made to control diseases either by pruning or spraying.

(4) Mildew infection is common in all orchards below 5,000 feet altitude, and in numerous cases paves the way for infection by die-back fungi.

(5) Marketed fruit contains an abnormally high percentage of breakdown due to rots resulting from infection contracted in the orchard.

(6) Where sprayng schedules are followed and orchard hygiene practised, little trouble is experienced with the more common parasitic diseases.

To sum up, it may be said that old trees are in most instances badly affected by such diseases as black rot, canker or die-back and are in need of immediate treatment. New plantings are relatively clean, but many show a dangerous amount of mildew. Where plant protection measures have been put into efficient operation, however, considerable improvement in trees can be seen within a short period, and this improvement is reflected in a reduction of fruit rots.

It will therefore be to the benefit of the apple industry if efforts are made immediately to eradicate diseases from the old orchards and to employ every reasonable method to protect the new plantings.

Descriptions of Diseases.

The more common diseases will now be described in detail and recommendations for their control by pruning and spraying made at the conclusion of this article. Control of root diseases is dealt with under the appropriate headings.

BITTER ROT (*Glomerella cingulata* (Stonem.) S. & v.S.).

On Branches.—This fungus causes irregular cankers to form, but appears to be rare on branches in this Colony. It has been recorded once following locust injury.

On Fruits.—The first sign of bitter rot on fruits is a small, light brown, sunken spot, suggestive of insect injury, which rapidly increases in diameter and may appear zoned. (Pl. II.; fig. 6.) Shortly after the rot commences, small black blisters appear in the centre of the diseased area, spread outwards and are frequently arranged in concentric circles. The blisters increase in size, causing the skin to rupture, and pink, moist looking pustules of spores are exposed. (Pl. II., fig. 5.)

The disease may be present in the orchard or may only develop in storage. Infected orchard apples fall early or become "mummied" on the trees, the "mummies" being a source of infection to healthy fruit.

BLACK ROT (*Physalospora obtusa* (Schw.) Cooke).

On Branches.—This fungus, which is a wound parasite, causes a serious die-back of branches of apple trees. The chief place of entry appears to be untreated pruning wounds or other mechanical injuries. It may also penetrate through small areas of bark killed by mildew.

The bark becomes roughened into minute blisters by the fruiting bodies (pycnidia) which develop underneath it. It eventually ruptures and the black pycnidia, containing the spores which carry the disease to healthy trees, can be seen in the cracks, or the "skin" may peel off leaving the pycnidia exposed. The bark in the diseased area is often discoloured by reddish brown to black concentric zones and, as the disease advances, the bark may split, the cracks so formed encircling the stem, the bark curling up to show the wood underneath.

Very young infected branches do not appear to crack and peel to the same extent as older branches, but the many scattered fruiting bodies show up very clearly. (Pl. III., fig. 11.)

On Fruits.—Fruits affected by black rot show first of all small circular brown areas, which rapidly increase in size, and soon a firm, spongy rot as distinct from the soft pulpiness of bitter rot, affects the whole fruit. It eventually becomes black and shrivels up, remaining on the tree in the condition known as "mummied."

A few specimens of fruit affected by black rot have been observed following hail or other damage, but the disease does not appear to be as serious as bitter rot on fruits.

Wounded and unwounded apples were inoculated with the fungus which had been isolated from a diseased twig. The wounded fruit developed a firm black rot, the skin being covered with thousands of small black pycnidia* similar to those found on the branches. No rot developed in the unwounded fruit.

BRANCH ROT (*Schizophyllum commune* Fries).

On Branches.—This disease may easily be recognised by the presence of grey, mushroom-like bodies which grow out, more or less at right angles, from dead branches. (Pl. III., fig. 10.) The under surfaces are brown and divided into partitions or "gills."

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*Perithecia of *P. obtusa* have been found occuring naturally on diseased branches.

These bracket-fungi, as they are called, are the spore-bearing parts of the parasite, the spores being produced on and shed from the "gills."

This fungus is but weakly parasitic in Rhodesia and is never found on vigorous trees. If often follows canker, black rot or die-back or may infect branches injured by unsuitable spray fluids. Once infection is established, however, the fungus grows rapidly down the branches and has been known to kill a weakened tree in one season. Branch rot also occurs on other deciduous fruits and citrus, and instances of plum trees being killed by the disease within six months of the application of too concentrated oil sprays have been seen.

Control is effected by suitable pruning and spraying to keep out other wood destroying fungi.

CROWN GALL (*Bacterium tumefaciens* E.F.Sm. & Towns).

This disease, known sometimes as plant cancer, affects roots and stems and is caused by a soil-inhabiting bacterium. The germ penetrates parts of plants in contact with the soil causing soft or hard galls to form, greenish, smooth and fleshy when young, but hard, dark in colour and roughened when old. Typical crown galls are shown in Pl. IV., fig. 13.

Control.—Avoid planting infected nursery stock. Young trees should be closely examined before planting, and if the disease is found to be present they should be destroyed. As a precaution against invisible infection it is a wise policy to soak all new nursery stock for 2 hours just before planting in a solution of bluestone (7 ozs. to 20 gallons of water). This should not be done immediately after fumigation.

If infected trees (including stone fruits) are present in the orchard, they should be uprooted and burnt, as many roots as possible being removed from the soil. If the disease is slight, the galls may be cut out and burnt and the wounds painted with carbolineum. Excision is not, however, satisfactory if the crown of the tree is largely infected.

The soil from which the trees have been removed should be well soaked in formalin (1 part to 25 parts of water) and the hole remain unfilled for a year.

DIE-BACK AND CANKER (*Botryosphaeria Ribis chromogena* Shear, Stevens and Wilcox).

On Branches.—The first evidence of this disease on branches is the presence of many small raised blisters underneath the bark. These cause the bark to rupture and jagged cracks are formed in which the black fruiting bodies (pycnidia and perithecia) can be seen. It is in these that the spores which spread the disease to healthy trees are formed. As the fungus develops the diseased area extends up and down affected branches and fruit bodies are produced in such abundance that the whole of the cankered area appears black as though coated with soot. A black substance may be washed down the branch by rain leaving black streaks on the surface of the bark.

The fungus was first isolated from a dying apple tree, the trunk of which showed symptoms of attack. It appeared to have gained entry through a split in the crotch.

On Fruits.—Wounded and unwounded apple fruits were inoculated with the fungus from the above mentioned isolation. Disease developed very rapidly in the wounded fruits, starting as a light brown rot round the points of inoculation. The rot soon spread and darkened in colour. After a few days, small black spots were observed in the more advanced rotted area, and these spread rapidly until the entire apple was covered with black fruiting bodies. Drops of liquid oozed through the skin and remained in globules on the surface. (Pl. II., fig. 8.)

The sound apples did not rot for some time, but eventually developed the same symptoms as the wounded.

Numbers of apples with this unpleasant wet rot, exhibiting the symptoms observed in the inoculation experiments, have been seen in storage during past seasons. As infection is carried to neighbouring fruits in the liquid that is liberated, it will readily be understood that one infected apple may cause an entire box to become unsaleable if stored for any but a short period of time.

Infected apples usually appear to have been punctured by insects or damaged in some other way, and it is through these wounds that the fungus gains entrance. However, inoculation experiments show that unwounded apples may also be affected.

Botryosphaeria Ribis chromogena has been found causing canker of avocado and guava trees, and inoculation experiments have shown that the fungus isolated from these trees causes a rot of apples.

DIE-BACK (*Valsa leucostoma* (Pers.) Sacc. and *Phomopsis Mali* Roberts).

Die-back caused by the fungus *Valsa leucostoma,* probably enters through pruning wounds and other mechanical injuries. The leaves on the diseased limb wither, and gumming takes place between the healthy and diseased portions of the branch. Later, tiny fruiting bodies appear pushing up through the dead bark. When mature, they can be distinguished from those of other previously described fungi, by the presence of a minute white spot in the centre of each.

The die-back caused by *Phomopsis Mali* closely resembles that due to black rot and may be controlled by the methods advocated for that disease. (Pl. I., fig. 3.)

BRANCH BLISTER FRUIT CRACKING OR ROUGH SCAB (*Coniothecium chomatosporum* Cda).

On Branches.—This disease is common on one to two-year-old laterals, but is usually complicated by secondary infection on older branches, so that the blister symptoms are not recognisable.

It appears in the form of small, light brown blisters, arranged singly or in groups. They may coalesce to form larger blisters, which later split and form irregularly shaped cankers. The characteristic symptoms are frequently found on branches of the less hardy varieties.

On Fruits.—Fruits affected by *Coniothecium chomatosporum* are very characteristic in appearance. Those infected early develop large, unsightly cracks (Pl. II., fig. 7) on the insides of which a dark, grey-green growth may develop. This growth may be the fructifications of the fungus, but is frequently found to be another fungus (*Alternaria* sp.) which establishes itself in the cracks and causes the fruit to rot.

Apples infected later in the season have a scabby, russetted appearance, the infection usually being heaviest round the stalk. Ohinemuri variety is particularly susceptible.

MILDEW (*Podosphaera leucotricha* (Ell. and Ev.) Salm.).

This disease is particularly widespread and severe in Southern Rhodesia, especially at altitudes below 5,000 feet. Of the popular varieties grown, Rome Beauty is especially susceptible, but the following are also seriously attacked: Cleopatra, Greening, Reinette du Canada, Wine Sap and Lord Wolseley.

A full description of the disease was published in the Journal in June, 1938(¹), but it appears to be of such importance to the apple industry that no excuse is made for repeating its life history.

". . . . the mildew fungus grows over the bark of new wood, covering it with a white felt, which consists of a densely woven mat of very fine threads. From these threads, tubes, by means of which the fungus withdraws nutriment for its sustenance, are forced into the surface cells of the apple twig at the same time killing them. Fortunately the fungus does not penetrate more deeply into the tissues of its host, and is therefore vulnerable to attack from outside the plant. However, some strands of the fungal mat, which grows over the shoots, penetrate beneath the scales surrounding the young buds and remain dormant during the winter months, only becoming active when bud movement begins in spring. The fungal strands commence to grow over the newly-formed leaves as they emerge from the opening buds, starting the disease up again. The fungus then continues to grow over the surface of the infected leaves, and soon produces millions of spores which give to the diseased areas the well-known powdery appearance characteristic of this type of mildew. These spores are scattered by wind and rain, and when they alight on a new leaf and conditions are favourable, they germinate and send out strands to form a fresh fungal mat, which grows down the leaf stalks on to the new shoots. If not removed, it remains dormant during the winter, only to initiate a fresh outbreak in the following spring."

The disease attacks leaves, shoots and fruits. Its powdery appearance on upward curled leaves is impossible to overlook, but its occurrence on newly expended buds and new shoots is not always observed by growers. Illustrations of new shoots killed by mildew are shown in Pl. I., fig. 1. The death of these new shoots not only retards the growth of trees, particularly young trees, but also affords entry to the various die-back fungi.

Experiments carried out in recent years have shown that mildew may be controlled by suitable methods of spraying and sanitation, which will be described later. Eradication from the nursery is particularly desirable.

NURSERY ROOT ROT (*Sclerotium Rolfsii* Sacc.).

This disease is common on young trees in nurseries where the soil is allowed to become excessively wet either through insufficient drainage or excessive irrigation during hot dry weather.

Diseased plants commence to wilt. If the roots are examined they will be found to be affected by a soft, wet rot and strands of a white fungus will be seen growing on the surface of the bark. Usually, attached to the fungal strands are small white or pale brown spherical bodies, the latter resembling mustard seeds. These are the sclerotia, or resting bodies, of the fungus and serve to identify the disease.

Root rot may be very troublesome in nurseries, but can be got rid of by improving soil conditions, particularly drainage. Slightly affected trees recover from the disease if given a favourable environment, but badly diseased plants should be dug out and burnt.

SOOTY BLOTCH (*Gloeodes pomigena** (Schw.) Colby).

On Fruit.—The sooty blotch fungus is purely superficial, and does no actual damage to the flesh. However, it causes black blotches on the skin which resemble a powdering of soot and spoil the appearance of the fruit, lowering its market value. (Pl. IV., fig. 14.)

Bleaching treatment should be used to remove the spots but sooty blotch is generally controlled by the usual spray programme.

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*Mature fructifications of the sooty blotch fungus on apple have not been observed in Southern Rhodesia.

Bleaching can be accomplished by dipping the fruit for a few minutes in a solution of chloride of lime and bicarbonate of soda in the proportion of 4 to 3, dissolved in water. A usual strength is 5% chloride of lime. The fruit is dried before packing.

SOFT BROWN ROT (*Alternaria* spp.).

On Fruits.—There is more than one *Alternaria* which causes rots in apples, but as they are symptomatically similar they may be dealt with together.

Alternaria has already been mentioned as being secondary to the fruit cracking fungus (*Coniothecium chomatosporum*). It may follow any injury caused by such agencies as hail, insects or sun scorch in the orchard, and has been found on several occasions following bitter pit.

Injured and uninjured apples have been inoculated with the fungi, which have been shown to be wound parasites only.

The rot starts as a brown spot, soft to the touch, which increases in size fairly rapidly. If the rotting apples are kept for some time in storage, the fungus, which is of a dark, dirty green colour, grows out to the surface, appearing as a mouldy coating on the skin.

STORAGE MOULDS.

There are a number of variously coloured moulds which cause apples to rot in storage, and several may be present in one fruit. *Aspergillus niger* and *Rhizopus nigricans* occur from time to time in Southern Rhodesia, but the most common cause of breakdown is the blue-green *Penicillium expansum*.

MOULDY CORE.

Apples which outwardly appear to be quite sound, may, on cutting, be found to have various moulds growing in the core, causing the surrounding tissues to rot. Varieties such as York Imperial, with open calyxes through which the spores of these moulds enter, are most susceptible.

BITTER PIT (Non-parasitic).

This disease is of common occurrence on most varieties, although Versfeld's, Blenheim Orange and Cox's Orange appear to be particularly susceptible, the fruit often being affected whilst still on the trees.

The symptoms, which are generally known to most growers, usually appear after the apples have been kept for a short time in storage. Small, black, depressed spots appear on the skin and may enlarge to about a quarter of an inch in diameter. If numerous, they may coalesce to form black, irregular depressions.

If these spots are cut into with a knife, a brown corky area will be found in the flesh directly beneath them. If the fruit is further cut into, small, often mere pinpoints, of brown, corky tissue will be found to be scattered through the flesh. Fruit affected in this way has a characteristic faintly bitter taste, whch has given the name of bitter pit to the disease.

The trouble is attributed to an insufficient supply of water for those parts of the fruit which are ripening.

The cells of the immature fruit are packed with starch and ripening consists roughly of the conversion of this starch to sugar, during which process water is required. If, for some reason, this water cannot be supplied by the tree, then the ripening cells draw water from the tissues surrounding them until a stage is reached where the last cells to give up water are unable to obtain any more. Under these circumstances they die and a corky layer is formed round them as a natural wound reaction on the part of the plant. The small corky spots form the characteristic symptoms of the disease.

In Australia, New Zealand, America and elsewhere, internal corkiness is attributed by some workers to a deficiency of boron. This hypothesis is being tested in Rhodesia.

WATER CORE (Non-parasitic).

This disease is also of common occurrence and well known. It is particularly severe on the Ohinemuri (Dunn's seedling variety).

The exact nature of the disease is not yet fully understood, but recent work has shown that the trouble is associated with periods of depressed transpiration in the plant, high fruit temperatures on the trees, light cropping and large fruit.

Satisfactory control measures are not known, but excessive thinning of trees in order to produce large fruit of susceptible varieties should be avoided.

LITTLE LEAF (Zinc deficiency).

Trees affected by this disease are generally classified as "unthrifty." Growth decreases year by year, leaves take on a yellow colour and are produced in small bunches at the tops of the branches. Often, bunches of large leaves are produced at the bottom of the tree and, although the leaders fail to make growth, long, thin shoots may be sent up from the bases of the laterals. The typical appearance of a tree badly affected by "little-leaf" is shown in Pl. III., fig. 12.

The cause of the disease is a deficiency of zinc in the tree, which for reasons not yet understood, is unable to absorb this element from the soil.

Young trees are seldom affected, but the first "little-leaf" symptoms usually appear about the sixth year after planting in Rhodesia.

Recovery may be brought about by treatment with zinc. Various methods have been tested in other countries, the most satisfactory results being obtained by spraying twigs and branches during the dormant season with a solution of zinc sulphate in water (see spray schedule). This treatment has yielded satisfactory results in Rhodesia.*

MEASLES (Cause uncertain).

A disease, which is characterised by the production of pimples and black spots in the bark and is probably identical with what is known as measles, is found affecting Jonathan and White Winter Pearmain varieties. It is probably due to a deficiency of plant food substances in the soil, and recent work in Australia and America suggests that the absence of the mineral boron is the underlying cause of the trouble. Applications of borax (¼ to ½ lb. per tree according to age) are being tried locally, but further experimentation is required before recommendations for control can be made.

Control Measures.

These are divided into three classes, namely (1) elimination of sources of infection or orchard hygiene, (2) protective spraying, and (3) in the case of mildew only, curative spraying.

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*Pears, peaches, apricots, plums and grape vines are also affected in Rhodesia. Treatment with zinc sulphate is effective, but the concentrations of the spray fluid vary for the different fruits.

Orchard Hygiene.--It has been remarked earlier in this article that nearly all orchards carry a large amount of dead wood. These branches are only dead as far as future growth is concerned, but are very actively alive in spreading disease from limb to limb and from limb to fruit. What appears to be merely a dead twig or shoot is in reality a teeming mass of fungus growth, which if left unchecked will eventually kill the whole tree as well as its neighbours. If apple growing is to be made into a profitable proposition, and especially if an export market is visualised, *every piece of dead wood must be removed from every tree every year.*

In cutting out diseased wood it is necessary to be ruthless. Not only the obviously dead branches must be removed, but it is necessary to cut at least three inches into green wood below the last visible point of discolouration. If the discoloured wood extends from a small lateral into a larger limb, then the large limb must be cut back. If the infection extends far down the large limb to near the crotch of the trunk (as is the case in many orchards), then it may be necessary to remove all the branches and top work the tree again. The essential point to remember is that the die-back fungus penetrates beyond the visibly infected wood, and if not removed will continue to advance and cause further die-back, eventually killing the tree.

It will be found that a very small island of discolouration may extend down the heart wood well in advance of the actual die-back, and it is because growers allow this diseased fragment to remain that die-back progresses despite the efforts made to eliminate it (Pl. III., fig. 9).

Furthermore, it is very necessary to protect all wounds, particularly pruning cuts, with a disinfectant, and for this purpose Bordeaux paste* (1 lb. powder to 2 gallons water) should be used. The treated wound should later be given a coat of Stockholm tar as a permanent protection. These precautions are found to be imperative under general Rhodesian conditions, where die-back and canker forming fungi appear to be far more persistent and aggressive than in more temperate countries.

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*Carbolineum may be used in the case of large wounds on trunk, laterals and roots.

On many trees cankers can be seen to be forming round wounds caused by cultivating implements, oxen, etc. These cankers should be cut out, well back into the green wood, and treated with carbolineum and Stockholm tar. It is, however, a much safer policy to treat wounds immediately they are made and thus prevent parasitic fungi from gaining entry to the tree. This is specially important when the trunk of a tree is injured.

In addition to removing the dead wood, all "mummied" or withered fruit attached to the trees should be collected, as these are sources of infection for both fruits and branches.

This work should be carried out in the dormant season (June and July), and all debris must be brought together and burnt as soon as possible. The destruction of all this rubbish is of the utmost importance, for if allowed to remain in the orchards the disease-producing fungi which it contains will liberate millions upon millions of spores which will start the troubles all over again.

(2) **Spraying.**- As explained in the previous article(1) in this *Journal*, for spraying to be an economical proposition, a schedule must be devised for the simultaneous control of mildew, die-backs, fruit rots and insect pests. This involves a series of applications of combined fungicides and insecticides aimed at attacking the parasites in the most vulnerable parts of their life histories.

As the result of spraying trials carried out in the past years the following spray schedule is recommended for use under Rhodesian conditions. The full spray programme is necessary where apples are grown commercially below 5,000 feet altitude but gardeners and small growers may omit applications Nos. 2, 5 and 6.

Spraying must be carried out precisely at the correct times, which are fixed according to the stage of development of the fruit buds. In the past much difficulty has arisen regarding the time of application of sprays owing to the irregularity of blossoming which occurs in Rhodesia. It has been found, however, that the use of miscible oil in the winter spray fluid not only controls scale insects and mites, but also induces accelerated and much more uniform blossoming; one application of oil during the dormant period is sufficient for the season. This, however, is not the case with fungicidal sprays, which it is necessary to apply according to the following table:—

SPRAYING SCHEDULE.

Time.	Spray Ingredients per 100 gall. water.	Control of.
1. Dormant	A. 1st year, 50 lb. zinc sluphate. Subsequently, 20-25 lb. zinc sulphate. (Early July or late June). B. Lime-sulphur 7 gall. + Pestridol 4 gall. (Late July or early August).	Little leaf. Mildew, blister, bitter rot, scale, mites, late and uneven blossoming.
2. Green Tip	Lime sulphur 5 gall. + colloidal sulphur 2 lb. or Perenox 2 lb.	Mildew, blister, fruit cracking, bitter rot.
3. Pink	Lime sulphur ½ gall. + colloidal sulphur 2 lb. + basic lead arsenate 5 lb. + lethalate 6 ozs.	Mildew, blister, bitter rot, flower eating beetles.*
4. Petal Fall	Ditto.	Ditto.
5. Two weeks later	Lime sulphur ½ gall. + colloidal sulphur 2 lb.	Mildew.
6. Mid-January	Home-made Bordeaux } 8-8-100 + lethalate 2 oz. KY-Bordeaux } or Perenox 2 lb.	Bitter rot.

*It has been found in practice that lead arsenate applied at this time helps to control blossom eating beetles. No exact information on this point has as yet been obtained, but the Division of Entomology recommends the use of this insecticide on emperical grounds.

The stage of bud development on which this schedule is founded may be described as follows:—

TIMES FOR SPRAYING.

Dormant	When leaves have fallen and before buds begin to swell, approximately between mid-June and the end of July. (*Zinc spray*—last week of June or first week in July. *Oil spray*—end of July or before the buds commence to expand).
Green tip	When the green tips of the leaves first protrude from the buds.
Pink	When the fruit buds are showing pink but before the petals unfold.
Petal Fall	When the majority of blossoms have fallen, but whilst some remain on the trees.

Proprietary brands of lime sulphur (39% polysulphide content) are sold in Rhodesia and can be obtained through most horticultural stores. Two brands of colloidal sulphur are marketed under the names of "Capoidal Insecticide" and "Sulsol." Bordeaux may be obtained as a ready mixed powder ("Dry Bordeaux") or done up in separate packets of copper sulphate and hydrated lime ("Ky-Bordeaux"), the latter being a much superior product, suitable for fruit tree spraying. A copper compound, "Perenox," may be substituted for Bordeaux.

A miscible oil, "Pestridol," has been tested with satisfactory results in Rhodesia. It advances the blossoming period by two or three weeks and induces a more uniform production of flowers.

The spreader recommended is "Lethalate Wetting Preparation," but other spreaders are also stocked by most firms.

The concentration of spray fluids recommended in the schedule have been tested on the following varieties without causing appreciable injury:—Rome Beauty, Versfeld's, Ohinemuri (Dunn's seedling), Jonathan, Delicious. Ohinemuri variety is somewhat sulphur-sensitive and slight scorching of the edges of some leaves occurred, but no damage of fruit was observed. Fruit scorch was caused on this variety when colloidal copper was substituted for Bordeaux mixture in the final spray. No damage has been observed with the use of "Perenox" in place of Bordeaux mixture, and satisfactory control of bitter rot has been obtained with it. It must be emphasised, however, that deviations from the concentrations recommended may result in severe scorching of leaves and russetting of fruit.

To growers unacquainted with commercial fruit growing the above spray programme may appear somewhat elaborate, but if a profitable industry is to be established, fruit must be marketed free from disease so that it will keep in good condition for several months. Storage rots are intimately connected with orchard conditions, and in most cases are a direct result of infection contracted before picking, and it is most important for growers to appreciate fully this relationship. Only by adopting a programme which is designed to control all the important diseases and pests can growers hope to grow fruit in quantity at a profit.

Another matter of importance is the spraying equipment. It is generally accepted to-day in apple growing countries that pressures of 300-400 lb. to the square inch are necessary for efficient control of all diseases and pests. Such pressures, of course, can only be obtained from a power sprayer, and growers who contemplate planting trees by the thousand will in a few years time be faced with the necessity of purchasing such equipment. For the small orchardist with a few dozen young trees, a pump giving a pressure of from 90 to 150 lb. per square inch will suffice, provided it is fitted with 20 to 30 feet of $\frac{3}{8}$ inch hose, extension tube (lance) and nozzle of the usual whorl type giving a fine spray. It should be noted that the so-called "Bordeaux" nozzle consisting of a tapered jet in an adjustable tap, is unsuitable for fruit tree spraying. It was patented in 1878 and has undergone little modification since. It is wasteful and produces a coarse spray with poor covering properties.

Numerous types of pump are in existence. Growers wishing to replace their old equipment should consult the Division of Plant Pathology before placing their orders.

As a final word of advice it will not be out of place to emphasise the utmost importance of **thoroughness** in disease control operations. Particular attention must be paid to detail, and instructions followed to the letter if satisfactory results are to be obtained.

SUMMARY.

1. The more common diseases of apples encountered in most orchards in Rhodesia are described.

2. Recommendations are made for the control of these diseases by a new spray schedule and other means.

3. Advice is offered regarding spray equipment.

REFERENCES.

(¹)Hopkins, J. C. F. and Bacon, Aline L. "Common Diseases of Apples and their Control in Southern Rhodesia." *Rhod. Agric. Journ.*, xxxv. 6, p. 452, 1938.

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3.

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PLATE I.

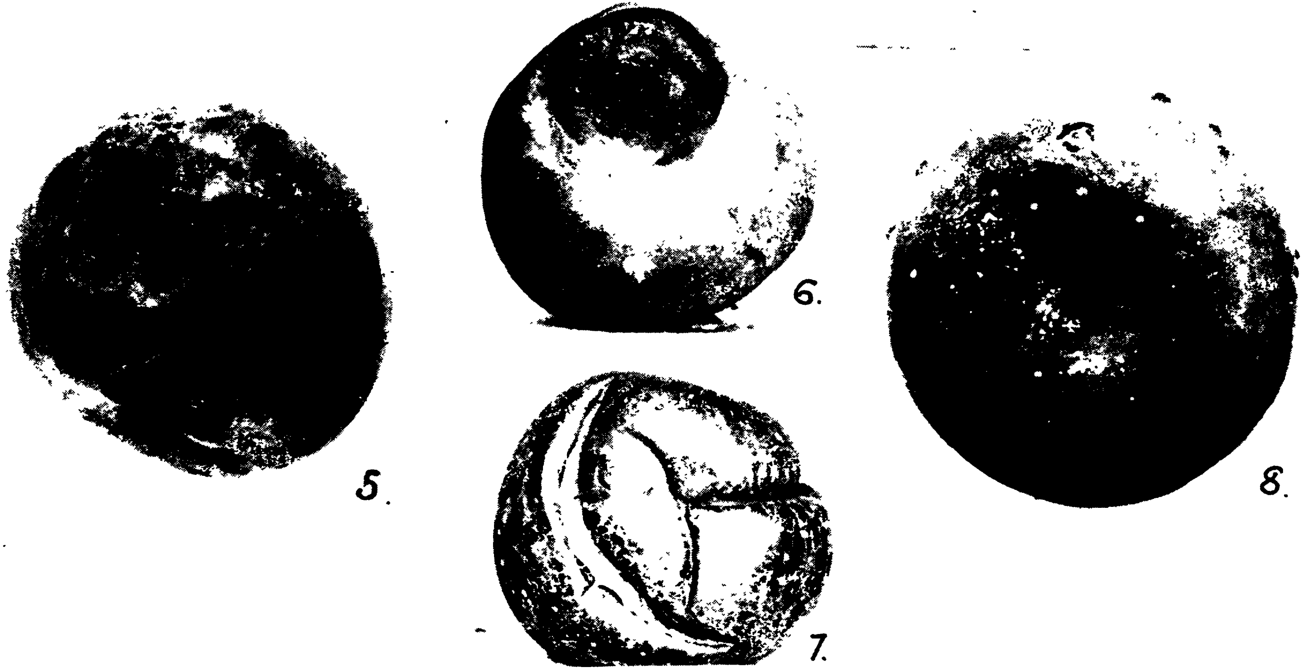

PLATE II.

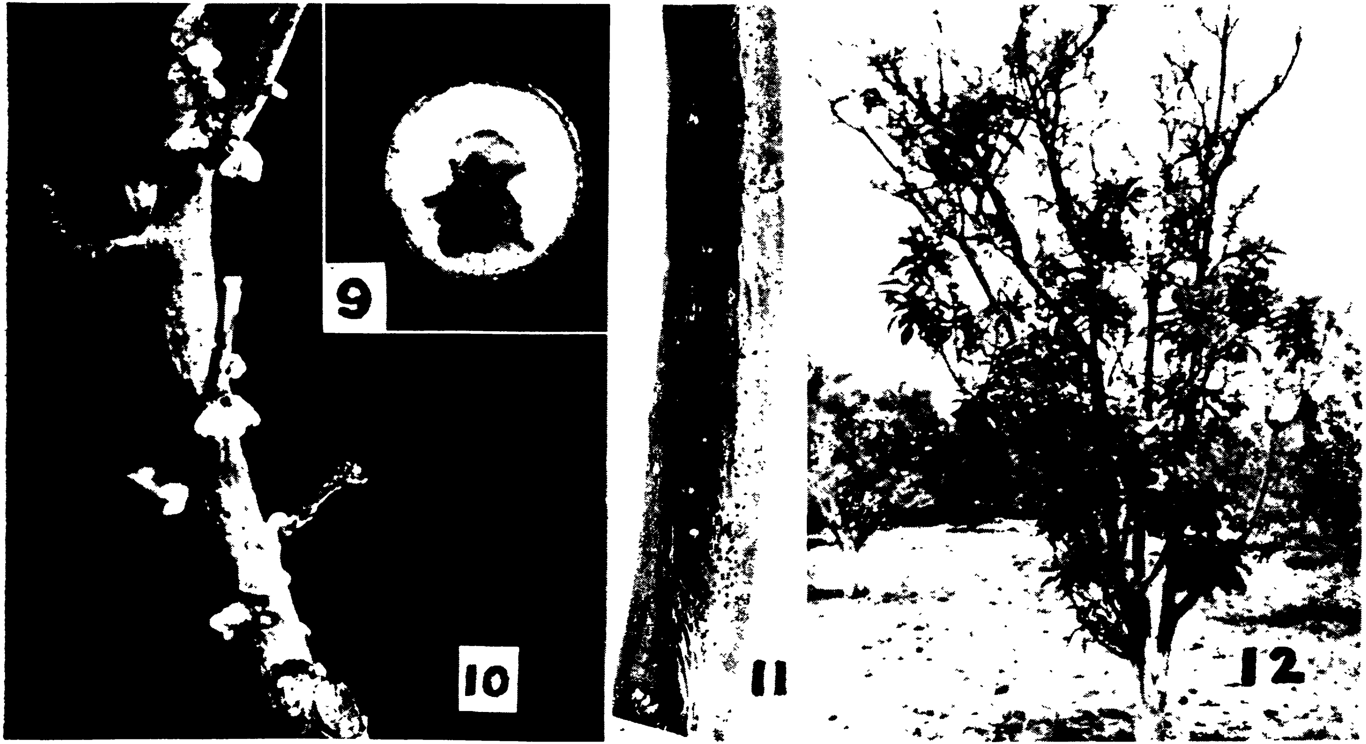

PLATE III.

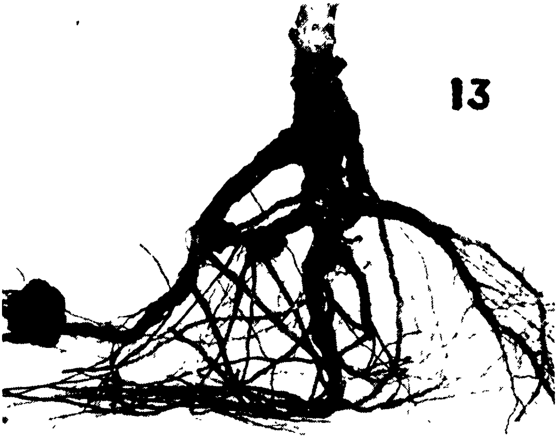

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PLATE IV.

EXPLANATION OF PLATES.

Plate I.

1. New apple shoots killed by mildew.
2. "Measles" on Jonathan variety second year wood.
3. Die-back and rough bark of White Winter Pearmain caused by *Phomopsis Mali* followed by the fungus *Fracchiaea heterogena*.
4. Canker developing from pruning wound. If unchecked, this disease will penetrate to the trunk and kill the tree.

Plate II.

5. Advanced bitter rot, showing pustules of spores.
6. Bitter rot four days after first visible signs of disease.
7. Fruit cracking of Rome Beauty variety caused by the fungus *Coniothecium chomatosporum*.
8. Wet rot of fruit due to the canker fungus. Note the drops of moisture oozing through the skin, and fruit bodies of the fungus at top left of the apple.

Plate III.

9. Section through the end of the branch in fig. 11, showing extension of black rot in the heart wood beyond the limit of external visible infection.
10. Spore bodies of the branch rot fungus on dead branch of apple.
11. Spore bodies protruding through the bark of a branch infected by black rot (see fig. 9).
12. Apple tree showing advanced "little leaf" symptoms. Note large leaves at bottom and small leaves and dormant buds at top of tree.

Plate IV.

13. Crown gall on roots and crown of peach.
14. Sooty blotch on pear.

Working Loam Soils for High Yields.

By D. AYLEN.

THE ROLE OF SOIL CONSERVATION.

Soil conservation works are not in themselves an "end" but rather a "means to an end," which is constant high yields through maintenance of fertility and also the ultimate easier working of the land. In an attempt to describe this feature the Americans have recently coined the phrase "*Productivity Maintenance.*"

Farmers are apt to regard soil conservation as a necessary evil and do not realise that soil conservation in the broadest meaning of that term aims at the economic attainment of high yields, nor do they realise that the technique is based on the practical experience of other farmers who have proved more successful in their methods of adoption of one feature or another.

Soil conservation therefore implies not only the construction of protective works, but includes all practices designed to improve the soil and increase fertility, as any such measure increases the resistance of the soil to erosion. The measures discussed in this article, and which up to now have not been regarded with sufficient importance, are the time and methods of working the soil. An attempt will be made to show why they affect the crop yields and the resistance of the soil to erosion, and in fact why measures designed to accomplish one accomplish both.

There is one exception, however—artificial fertiliser—which does not directly increase the soil's resistance to erosion. Even in this case it indirectly assists in reducing erosion owing to the greater amount of plant growth induced, and the greater bulk of green crops grown will increase the supply of humus-forming material.

Lime, however, comes in a different category, as it has a direct beneficial action in improving the structure (or tilth) of loam or clay soils, particularly if it is applied when decaying vegetation is present. The action of the combined measures has a greater effect than the sum of two applied singly. Incidentally it has also been observed that the quicker that applied organic matter decays to humus the greater the improvement of the soil structure. It is possible that the effect of lime on decaying vegetation is to accelerate its decomposition.

The effect of Sheet Erosion on the Tilth.—It is well known that working even a loam soil when wet puddles or compacts it, but it is not generally realised that the soil can be damaged in the same way when it is hardly more than damp. Still fewer realise that such damage decreases both crop yields and resistance to erosion. Sheet erosion by weakening the soil increases the liability of a soil to puddling. If the soil is deficient in humus the resistance to erosion and puddling is further reduced. These various factors are therefore complementary, and for that very reason, and also due to the fact that deterioration is gradual but persistent, one or another is often overlooked as a reason for decreased yields and increased difficulties of working the soil.

To what extent erosion induces compaction cannot be determined accurately; but the practical farmer knows that a land that has been flattened by a moving sheet of water is harder to plough. Even if the moving water does not cause sheet erosion, it has the effect of removing a considerable proportion of the finer soil particles from the upper layer of the soil and thus damaging its structure. Soil structure is one of the major factors which determine yields. In fact, in our climate, it is perhaps the major factor.

Erosion is rapid and universal in Rhodesia.—Recent investigations have brought to light the fact that erosion is most rapid in those countries where evaporation is high compared to the rainfall. The reasons are that such conditions are not favourable to the formation of a resistant soil structure. These conditions apply to Rhodesia, and so once the protective natural cover is removed the exposed soil is readily eroded by rain water.

SOIL STRUCTURE.

It may appear to the casual observer that prevention of clods by avoiding "puddling" has little to do with the prevention of erosion or the attainment of high yields. This is not the case, and besides being a severe handicap to farming operations, the large hard clods so prevalent on Rhodesian loams are a symptom that the structure has deteriorated. Soils with poor or negligible structure have little resistance to erosion and can produce fair yields only during a most favourable season.

Soil is a mixture of different sized grains of insoluble material, *viz.*, sand of various sizes, silt, clay and colloids (the medium which binds the soil into crumbs and holds the plant food and water), and a lesser proportion of soluble minerals and humus. The texture of a soil is dependent on the proportions present of the various sizes of grains and clay. The structure is dependent on the manner in which the grains are grouped, the space between them, and the nature of the binding material.

The structure of a soil controls the amount of moisture that can be absorbed and made available for plants.

The binding material is composed of soil and humus colloids which are so minute that they form a mechanical combination with water of the nature of a glue.

In a soil of good structure channels made by burrowing insects or left by decaying roots will not collapse but will remain to act as ventilating shafts and thus permit of the ingress of air which will encourage the formation of more humus from decaying organic matter.

If the soil becomes weakened by erosion or humus deficiency the crumbs break up into individual grains. Puddling when wet or pulverising when dry shatters the crumbs.

It is seen therefore that structure is a physical condition of the soil. Soils of good structure possess all the following advantages:—

1. High capacity to absorb and retain moisture.
2. Great resistance to erosion.
3. Free drainage and absence of water-logging.

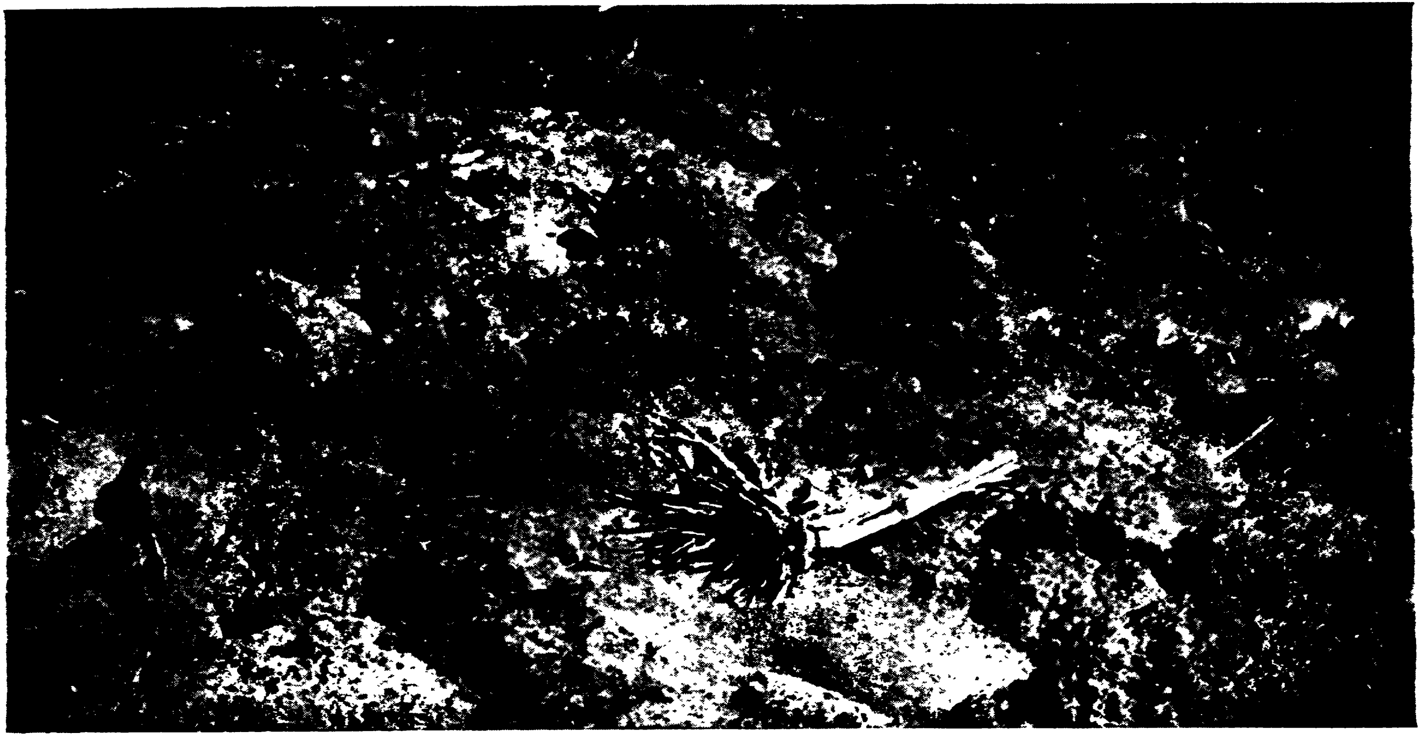

Fig. No. 1. Soil with a good structure.
(See opposite page).

DESCRIPTION OF ILLUSTRATIONS.

Two photographs of similar soil on adjacent lands which have been worked differently.

This soil has initially rather a poor structure and is therefore prone to puddling. Crop rotations are apparently similar but methods and timing of working the soil differ on the two lands.

The photographs were taken after the first rain of the season, when between 2½ and 3 inches fell during the night.

Fig. No. 1.—Extreme care has been exercised to avoid compacting this land, and working the soil has been restricted to times when damage would be unlikely.

Note that this first wetting and drying has commenced to crumble the clods into small lumps, and that they did not disperse to form mud. No rain water has been lost as run-off. The lightest implement would complete the shattering of these clods whilst in this condition, but if left, subsequent rains would complete the crumbling to form a roughish loose surface.

Fig. No. 2.—Though the methods employed on this land do not differ greatly from those which are commonly practised on maize farms the weak structure of the soil has collapsed and the dispersed soil now readily packs.

Note that the clods have almost completely "dissolved" and the rain-packed mud has dried out in this short time to a hard solid mass. It is evident in the photograph that the planter was unable to penetrate. The streaky marks show that during the storm there was some run-off and sheet erosion.

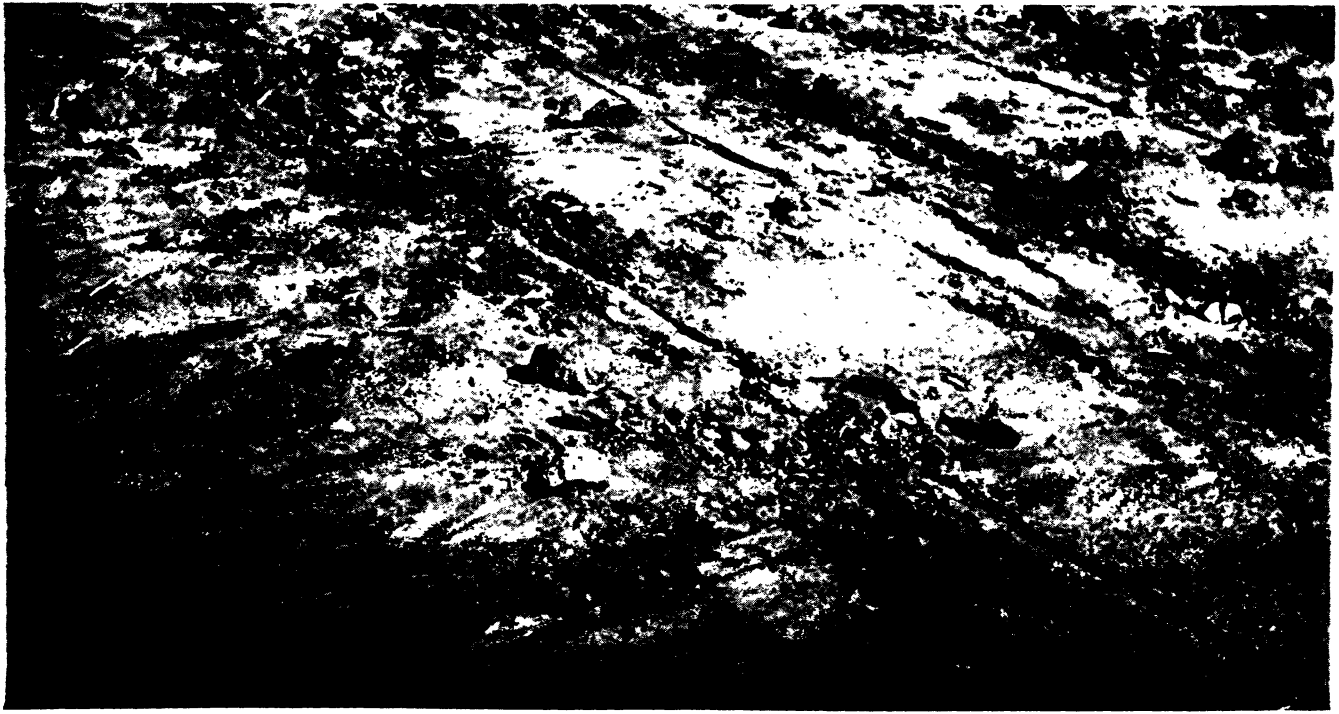

Fig. No. 2. Compacted Soil.
(See insert facing Fig. No. 1).

4. High productivity (if plant food is adequate).
5. Easy workability.

The perfect structure is only to be found in a virgin forest loam where the fallen leaves supply ample decayed and decaying organic material, and where rainfall is fair and fires non-existent.

The soil structure underlying thick undisturbed grass pastures in temperate climates often approaches the perfect state as grass roots are peculiarly effective in loosening a soil. The structure of the average Rhodesian maize soil is far from perfect even when the land is virgin and can be readily damaged by careless working. However, it is sufficiently good at first to produce high yields, and improvement can be effected by careful farming.

The hot, dry, winter climate of Rhodesia combined with veld fires for generations have prevented the formation of a loose friable or crumb-like soil structure. The climate without doubt is the lesser factor, as if fires had not occurred sufficient litter would have been built up to keep the soil cooler and moister all the year round than is the case. A surface mulch of forest litter not only holds the rain water and reduces evaporation, but it also provides food and shelter for the myriads of burrowing insects and worms which tunnel, turn over, and aerate a soil—a most necessary process in the formation of a fertile soil. Soil should not be a dead inert mass, but literally alive and full of bacteria and small animal life.

Though right from the start with a newly broken land there are certain disadvantages in Rhodesia, farmers working under even less favourable conditions in other countries have, by careful methods, built up their soils sufficiently to obtain high yields, and the few farmers here who have either built up the soil structure or prevented its deterioration now have the most easily worked lands and obtain the highest yields.

A perfect structure, similar to that of the undisturbed virgin forest loam, cannot be attained, but a structure sufficiently good to meet the demands of a high yielding crop can be maintained.

After plant food, availability of moisture is the deciding factor, and the aim should be to build up the soil to such a state that it can hold sufficient moisture to tide crops over dry spells without their growth being retarded.

THE EFFECT OF SOIL STRUCTURE ON CROP YIELDS.

Experiments have been carried out in other countries in which the capacity for retaining moisture and the rate of infiltration (drainage of surplus to depth) of water have been measured for soils of different structure, but otherwise identical in chemical and mechanical composition. As a check on field experiments samples of soil of good structure were examined in the laboratory, by dividing each sample into two. The structure of one half was destroyed by compacting (or puddling) it artificially. In both the field and laboratory experiments the method of comparison was the extent of growth made by an equal number of seeds or plants.

It was found that the proportion of seeds which germinated in the compacted soil was lower, and that root growth was severely restricted. The plants made less top growth and seed or fruit production was markedly smaller. Analyses of the plants showed that those grown on compacted soil had lower mineral and protein content. In other words, not only the bulk was less but its food value was lower.

Further investigation showed that fertiliser and other plant foods are not as freely available to plants in a compacted soil as in one of good structure.

Plants in compacted soil suffer to a markedly greater degree from drought. This is most apparent on the loam soils of Rhodesia. We have known that compacted soil is more prone to water-logging, but these experiments showed that when water-logging was induced to the same stage in the controls of good structure by adding more water, the plants did not suffer nearly so badly.

It was here that the new science of growing plants in tanks of water in which are dissolved a sufficiency of all the essential elements gave the answer. Under such circumstances the plants thrive best when the water is gently circulating and contains air or has an exposed surface from which it can absorb air. Up to that time the importance of the plant roots being able to breathe unrestrictedly was under-estimated. As long as the water contains air a plant in soil and water does not suffer hardship, but the water containing dissolved air must circulate to a small but definite degree. This shows that the damage done by so-called water-logging is literally suffocation of the roots.

In the laboratory, with a pot of soil that had been artificially compacted to the maximum, it has been found that a plant can show evidence of both water-logging and drought at the same time. The reason is that the water which is available to plants is held in the spaces formed by clusters of grains (crumbs). The power of extraction of water by roots is not sufficiently strong to absorb the water held as a molecular film covering the actual grains. If the crumbs are destroyed the grains then so closely fit together that there are no appreciable cavities and there is no water available to plants.

At the other extreme the "perfect" soil with an ideal structure can absorb water to the extent of two-thirds of its volume. Somewhere between the two there is a sufficiently good structure to meet the needs of high yielding crops. For that purpose the soil must be able to retain sufficient moisture, to carry crops over the droughty periods of our growing season. It must be sufficiently loose and light to absorb moisture, and yet sufficiently cohesive to resist erosion and open enough to prevent or nullify water-logging, and it must be tough enough not to flatten down to a compact mass during abnormal storms.

If such a structure on loam soils can be attained or maintained by applying adequate humus and carefully working it, and fertiliser is applied at a rate sufficient to make good any deficiency, high yields should be obtained during any season, except an absolute drought. The soil will also have the added advantage of being easily worked.

HOW SOIL STRUCTURE IS DAMAGED.

The problem of deterioration of soil structure appears to be more acute on Rhodesian loam soils than is general elsewhere. The climate, type of soil and farming methods, all play a part. It may be that the combination of conditions are in few other parts of the world so much against the maintenance or improvement of soil structure. Rhodesian clods are outstanding as regards size and hardness.

Soon after a land is broken from the veld the small tunnels and holes in the soil are destroyed by ploughing. The rootlets which bound together the crumbs decompose, and whilst the decaying vegetable matter present is converted into humus, replacement is often neglected. Humus is not a stable compound and, in fact, is only a stage in the decomposition of vegetable matter. The hot dry period before the rains is most unfavourable to humus, as at soil temperatures over 80° F. it oxidises rapidly and is thus lost.

After a few years of cultivation, unless the humus has been regularly replaced by green cropping or composting, etc., insufficient is left in the soil and the gummy substance which holds the soil particles diminishes in strength with a consequent reduction in its resistance to erosion.

The extent of the damage done each year becomes apparent by the increasing difficulties and delays in working the land (ploughing, harrowing, planting) and the period when any such operation can be undertaken becomes shorter. Our growing season is none too long, and this fact forces the farmer to inflict further damage in an attempt to get the crop under way. By strenuous efforts the soil may be worked into a fine "tilth," but this is not a true tilth and the first heavy rain flattens it down. Repetition of this process leads to further compaction and finally the farmer finds himself with a land most difficult to work and which will only produce large crops during a perfect season. Witchweed, erosion and the season are blamed, but ignorance of "soil husbandry" is also a major contributory cause. It is not out of place to repeat that "soil husbandry" includes erosion control, humus replacement and careful timing of ploughing, harrowing, etc. Once any of these principals have been neglected the damage unfortunately does not come rght on its own. Restoration requires considerably more time and effort than maintenance.

The appearance of loam soils of good and bad structure.—Much can be learnt by gently immersing a lump of soil in water. If the soil has a good structure it will crumble into smaller fragments but will not completely disentegrate into mud, which is usually the case with a soil which has been overcropped and otherwise badly worked. The term used to describe the breaking down of a soil to dust or mud is "dispersion," and a soil which does this readily is said to be "highly dispersed" or to disperse readily.

A soil that easily forms into hard solid clods is usually highly dispersed. In extreme cases the soil, when dry, will be a mixture of large hard clods, and a fine dust consisting of individual grains. When really wet the soil becomes like mud and packs down, cracking out into clods again when dry. A friable soil does not crack into hard clods when dried.

Many Rhodesian clods do not readily crumble when wetted, because the soil still has some colloidal clay and may even have some humus though an insufficient amount. It is probable in this case that repeated working when wet has so compacted the soil that its crumbiness or sponge-like texture has been destroyed. The soil is no longer elastic either. (Soil with a good structure is more elastic than is usually realised.)

With further deterioration the clods will tend to crumble more readily during rain, but the soil each year will pack down tighter than ever. On the other hand, soils of good structure are loose, friable, crumby with a large percentage of voids or spaces. They almost resemble pieces of chopped up sponge.

It has been noted that the run-off from and the erosion on puddled soil, even when contour ridged, is considerable, whilst on identical soil, but well worked, alongside, little or no water reaches the ridges except during heavy rains towards the end of the season.

TREATMENT OF THE SOIL FOR THE ATTAINMENT OF HIGH YIELDS.

It is obvious then that to prevent a soil becoming puddled, the first essential is to keep the humus content as high as possible.

Soil structure is greatly improved by green cropping, particularly with sunnhemp, always provided of course that the ploughing-in is not done when the soil is more than just damp. Some improvement is obvious even before the sunnhemp has rotted. The root system possibly has a loosening effect on the soil, but ploughing by itself can greatly improve the structure of the soil if undertaken when soil moisture conditions are ideal.

It is not possible to plough all the farm when the soil is just right; however it is possible to get nearer the mark than is the common practice. The simplest test in order to determine if the land is fit to plough is to collect some soil just below half the depth at which the plough will work. If it is somewhat difficult to work the soil into a ball in the hands and on crushing, the ball breaks into several pieces, conditions are ideal. If humanly possible never work the soil when it is wetter than this.

Any pressure on the soil when it is more than just moist will cause the collapse of small air pockets and also a re-arrangement of the soil particles into a more compact mass, therefore animals, tractors and implements should not be taken across wet land. It would seem hardly necessary to point this out, but some farmers are barely aware of the extent of the damage that is done, and that such damage is almost permanent. When the soil is even damp cultivation should be restricted to the minimum necessary for the control of weeds.

Every time a land is cultivated, harrowed or ploughed. except when barely moist, the actual implements crush, pulverise, or cut through and reduce in size many soil crumbs. The dust (or later mud) which is formed sets hard after being saturated and pounded by a heavy rain, whereby spaces are filled and portions, at least, of the soil become compacted or solid and hard. On some soils the use of rollers, clod crushers and pulverisers is distinctly harmful as dust rather than tilth is created.

Straw Mulches.—The ideal mulch is without doubt a straw mulch, and its advantages were first brought to notice in this country by Dr. Brain. The advantages are much the same as the forest litter mulch but to a lesser degree.

There is, however, another most striking factor which is that the rate of infiltration of rain water is immediately considerably increased. This is particularly noticeable when the soil is a "dispersed" clay loam. In such cases if the subsoil is not impervious water will continue to penetrate long after bare soil appears saturated.

Observations suggest that on a bare or poorly covered surface mud is formed by the rain, and first fine soil, and then clay and finally colloids choke the "pores," forming an almost impermeable skin on the surface which prevents the ingress of water.

Under a mulch it is obvious that less mud would be formed, but that does not appear to be the full solution to the problem, as even when muddy water is deliberately applied a shiny skin does not appear as the last of the surface moisture disappears as it does on a bare soil. On examination it appears that much of the fine clay collects on the mulch.

Labour problems, and on many farms, the restricted area which can be cut for hay, have dissuaded farmers from adopting the application of a grass mulch on a field scale, but grass mulches have been most effectively used in orchards. This subject is covered in the soil conservation bulletin on orchards.

Surface Mulches.—It has been found in America that if a dusty mulch is formed on the surface when the soil is wet underneath, and it then dries out, structure is improved. The soil dries out much more slowly under the dusty mulch and it appears that under these conditions the soil tends to form crumbs rather than crack into large clods which otherwise would be the case. It would therefore be advantageous on a compacted soil to create a dusty mulch after the rains have finished. With present methods of farming such a practice would only be possible on fallow and side-cropped lands or where maize is "wide planted." Though one hesitates in making any revolutionary recommendation that at first does not appear practical or economical to farmers, the suggestion that an endeavour should be made to create a dusty mulch at the end of the rainy season on any compacted soils which form hard clods should receive serious consideration. It would mean that the amount of time expended on the last hand cultivation would be considerably increased, and the use of a different implement from the common hoe might give a better result. However, the increased ease of subsequent working would more than balance this. The formation of a dusty mulch during the wet season has no advantages in this respect and has several disadvantages in fact.

Experiments elsewhere go to show that the infiltration rate for a dusty mulch is little different from that of soil with a rough surface (*i.e.*, small crumby clods) not pressed down. However, soil losses from a dusty mulch surface can be high at the beginning of a violent storm. The disadvantage of the dusty mulch is that the surface is not in the best condition to receive a subsequent storm as there is a tendency meanwhile for an impervious crust to be formed on the surface, and a cultivation between each heavy storm would be required to maintain the mulch. In that case considerable damage would be done. Evaporation losses are no greater, from a rough surfaced loosely packed soil than from a dusty mulch. A compacted soil with a smooth surface is in the most unfavourable condition for all purposes, namely, absorption of water, prevention of erosion and evaporation, and promotion of plant growth. The preparation of the soil in a roughish loose condition appears the most desirable.

Fallows and Leys.—One of the best methods to recover a soil which has become compacted is to turn it over to pasture for a number of years.

The land should be green-cropped and if possible fertilised before seeding in order that a thick crop of grass with a vigorous root system will be established, as it is the roots which improve the structure by opening up the soil.

Such rotational pastures, known as "leys," are a firmly established practice in many countries.

Fallows or leys should not be grazed by cattle when the soil is more than just damp, as the weight of the animals will compact wet soil to as bad or even a worse state than before.

When a fallow land is hard the soil structure could be improved by mowing the grass and weeds and leaving the mow to act as a mulch. Two mowings timed to catch growth when young in each case would ensure that the mulch would partially rot that season.

SOILS OTHER THAN LOAMS.

So far sandy soils and black clay vlei soils have not been considered. Sandy soil is composed of such coarse grains and has so few colloids that the particles are not bound together as a crumby structure.

However, sandy soil can be severely damaged by careless treatment. Grazing of fallow tobacco lands when wet can transform the soil into a state which sets like cement when dry.

It would appear that in this case pressure, when wet, causes some re-arrangement of the grains and they are forced into closer contact. Crumby structure, if any, is present to such a small degree that its destruction is of lesser importance.

A few vlei soils dry out into crumbs, but when saturated they all settle to a compact mass. Most vlei soils show an increasing tendency to form clods or crack according to the extent to which they have been utilised for lands or grazing. It is possible that living and dead grass roots (and in cases the mulch of dead grass) are almost wholly responsible for controlling cracking and the formation of clods, and as these are reduced the soil becomes less elastic. Pressure also would destroy the tunnels left by decayed grass roots.

The true role of the sticky black vlei which readily waterlogs is pasture rather than crops; however, some farms have not enough land of the loam type to be able to throw out such vleis without reducing production of cash crops below the economic minimum. Careful working and drainage type contour ridges assist crop production, but it must be considered only a matter of time before such vleis are abandoned to veld grasses or profitably utilised as rich grazing of planted pasture grasses.

PREVENTION OF WATER-LOGGING.

Not only does water-logging increase the tendency to puddling, particularly in lands deficient in humus, or when the soil has been over-pulverised, but puddling increases the tendency to waterlog, because the rate of absorption and infiltration is greatly reduced.

It is frequently impossible to prevent vleis water-logging during a wet season, such as the last one, for the following reasons:—

(1) The soil settles down to a compact mass when wet, and has naturally a very low capacity for absorption or infiltration.

(2) The soil is usually shallow and the sub-soil an impervious clay.

(3) Slopes are usually so gentle and "pans" or hollows also numerous, that surface drainage is very slow. However, the drainage type of contour ridges with a careful system of crop rows does help somewhat.

On loam soils it is only advisable to construct contour ridges so that they impound water in cases where the soil drains well, in districts where rainfall is light. In districts of ample rainfall the water should not be held back for any considerable time, rather the excess should be drained off. If these rules are followed and the land *carefully worked* water-logging will be most unlikely.

The water-logging of gently sloping clay loam soils often does not take place until some years after the construction of contour ridges. It is then caused by the gradual silting up of the channel. The subsequent restricted flow is so slow that fine clay is deposited, choking the pores of the soil. This problem is overcome in the first case by giving the contour ridges a slightly steeper gradient than otherwise would be used, and later by keeping the channel evenly graded, well-defined and clean. In other cases the original contour ridges are spaced too far apart with the result that silt deltas form at intervals in the channel, thus impounding stretches of water. In lands which tend to waterlog, the contour ridges should be so closely spaced that no silt will be washed down into the channel. In extreme cases where actual terracing has occurred, the old ridges should be broken down and new ones put in at close spacing, avoiding as far as possible the old ridges and the level strips immediately above them. Provided that the land is then subsequently ploughed so that the channel is kept open the cure is permanent.

SOILS TO AVOID.

Certain soils are not suitable for agricultural purposes. These soils are naturally compacted, are difficult to work, erode easily and have a very low capacity for absorbing water. In a few cases the cause may be due to the presence of a small quantity of sodium. This element has the power of destroying the colloidal humus-clay binding substance which holds the grains apart and makes the crumby structure. If this substance has been prevented from forming or has been destroyed, the soil will naturally be compacted to an extreme degree. A small amount of sodium can be neutralised by applications of sulphur and gypsum.

Another compaction which is more frequently encountered on farms, though fortunately only on relatively very small areas, is caused by the actual proportion of the sizes and shapes of the grains which make up the soil. These soils have the wrong assortment of grains for the soil ever to become friable.

In their natural state the grass cover is usually poorer on soils unsuited for agriculture (*e.g.*, Mopani veld) than elsewhere, but they can chiefly be distinguished by their hardness and the unduly large run-off which occurs during rain. When grazed the grass soon becomes thin and the surface rather bare and hard, if not already so. If cultivated the soil is sticky when wet, but rapidly dries out and packs down like cement. Most farmers leave out patches of such soil. Some struggle with it, but it is most unlikely that such soil could ever be worked economically because its composition is unsatisfactory, and this factor cannot be remedied. Once the natural cover is disturbed these unsuitable soils erode at an incredible rate, one feature of which is the formation of gullies with vertical and even over-hanging sides.

Annual Report of the Senior Animal Husbandry Officer

IN CHARGE RHODES MATOPO ESTATE AND GOVERNMENT EXPERIMENT STATION, 1/1/39—31/12/39.

By C. A. MURRAY.

From both the agricultural and livestock points of view Matabeleland farmers experienced a very good season. Crops were generally satisfactory and cattle wintered better than for many years.

Research work at the Station was expanded, but it is unfortunately not yet possible to devote adequate attention to crops and pastures.

An increased amount of extension and livestock work was carried out and there was greater demand for advice, especially from the more progressive farmers.

The World's View farm was proclaimed a National Monument and with other places of interest on the Estate was visited by thousands of tourists and visitors.

Educational.—Due to the abnormally wet weather during February and March and the impending Parliamentary election it was decided not to hold the usual annual Farmers' Day.

As pointed out above there was an increased demand for advice on livestock and other agricultural matters, but unfortunately there is still a section of Matabeleland farmers which shows no inclination to ask for or accept advice or improve its methods. It is gratifying, however, to record that this class is now smaller than a few years ago.

Livestock Improvement Scheme.– The enlarged Livestock Improvement Scheme has proved without doubt a great improvement on the old one and reached a large number of farmers who, under the old scheme, made no attempt to introduce new and better blood into their herds.

Correspondence.—Eleven hundred and thirty-five letters dealing with the Livestock Improvement Scheme and advisory work and 2,350 in connection with general administrative duties were dealt with.

Circulars.— During previous years I have occasionally sent to all Matabeleland farmers advisory circulars dealing with some aspect of farming. This method of disseminating advice has proved very useful and effective, and during the year under review 1,600 circulars were sent out in connection with:—

(*a*) The production of farm feeds in Matabeleland.
(*b*) The making of legume molasses silage.

Articles.—The following articles were published during the year:—

(*a*) *Report on Cattle and Chilled Beef Industries in South America*, by C. A. Murray. Rhodesia Agricultural Journal, Vol. 36, No. 3, March, 1939.
(*b*) *Feeding Young Stock in Winter*, by C. A. Murray and A. E. Romyn. Rhodesia Agricultural Journal, Vol. 36, No. 6, June, 1939.
(*c*) *Urea as a Possible Substitute for Peanut Cake for Wintering Young Stock*, by C. A. Murray and A. E. Romyn. Rhodesia Agricultural Journal, Vol. 36, p.p. 554, 1939.
(*d*) *Most Valuable Cattle Feeds for Matabeleland Farmers*, by C. A. Murray. "Bulawayo Chronicle," Nov., 1939.
(*e*) *Legume Molasses Silage*, by C. A. Murray. "Bulawayo Chronicle," Dec., 1939.

Several reports are in the course of preparation and will be published during the coming year.

Shows.—Cattle were exhibited at the Salisbury and Bulawayo Shows and I judged the livestock classes at Gwelo and Kafue.

Research.— Although research work was expanded during the year a number of very important problems still await investigation. The work in progress deals, however, with a number of major problems and below are given briefly particulars of the work completed or in progress during the year.

ANIMAL HUSBANDRY.

Nutrition.—Project No. 42.—Feeding of Na., Cl., and Fe., Supplements to Young Growing Steers.

Object.—To check the results of previous experiments in which it was found that there was no deficiency of these minerals in the pastures on this Station.

Groups—

(1) Control—Veld grazing only.
(2) —Veld grazing plus 1 oz. salt (Na. and Cl.) per head daily.
(3)* —Veld grazing plus 1¼ oz. salt and iron (Fe.) per head daily.

Results.—The experiment was continued for a period of two years, *i.e.*, through two complete summer and two complete winter periods. At the conclusion of the experiment there was not the slightest indication in regard to weight, growth, condition or health, that the animals in Groups (2) and (3) derived any benefit from the feeding of these minerals.

This experiment was completed during the year and a report is now being prepared for publication.

Project No. 51.—Mineral and Protein Supplements for Breeding Cows in Relation to Production and Reproduction.

Objects.—This experiment was commenced during the year. The objects are:—

(*a*) To check the results of our previous mineral work on ranch cows.

(*b*) To determine the effects of feeding a protein supplement to cows during the service period and, towards the end of the year, on the weight, type and quality of the offspring and the fertility of the cows.

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*The salt and iron mixture is the same as the one used in Florida and recommended here by the Chief Chemist. It consists of 100 lbs. salt, 25 lbs. oxide of iron and 1 lb. copper sulphate.

Groups—

(1) Control—Veld grazing only.
(2) —Veld grazing plus protein supplement.
(3) —Veld grazing plus protein plus mineral supplement.

Results.—The experiment has not yet reached the stage where any definite results are available.

Project No. 40.—Protein and Energy Deficiency Studies in Pastures.

Objects.—To obtain information as to the minimum protein and energy requirements of young growing cattle under ordinary grazing conditions.

Groups—

	1st Half of Winter.	2nd Half of Winter.
(1)	Control—Veld grazing only.	
(2)	Veld grazing and 1 lb. maize meal.	1½ lbs. maize meal.
(3)	Veld grazing and ½ lb. maize meal and ½ lb. ground nut meal.	1 lb. maize meal. ½ lb. ground nut meal.
(4)	Veld grazing and 1 lb. ground nut meal.	1 lb. ground nut meal. ½ lb. maize meal.
(5)	Veld grazing and 1 lb. ground nut meal.	1½ lbs. ground nut meal.

Project No. 48.—Ground Nut and Maizemeal as Supplements for Young Growing Steers.

Object.—While the previous experiment (3 above) was still in progress it was considered advisable to commence work immediately to check the very interesting results being obtained.

Groups—

(1) Control—Veld grazing only.
(2) —Veld grazing plus 1-1½ lbs. maize meal daily.
(3) —Veld grazing plus 1-1½ lbs. ground nut cake daily.

Results—

(1) The feeding of 1½ lbs. of maize meal containing .10 lbs. of digestible crude protein is of no apparent value to young cattle on natural veld.

(2) Any one of the following supplements, all of which have the same energy value as 1½ lbs. of maize meal, is of benefit.

1 lb. maize plus ½ lb. ground nut cake.
½ lb. maize plus 1 lb. ground nut cake.
1½ lbs. ground nut cake.

They appear to be equally effective, though the content of crude protein varies from 18% to 40%.

(3) It appears that for wintering young cattle on natural grazing which contains approximately 3% crude protein (exclusive of any browse) it is necessary to supply a minimum of approximately a quarter of a pound of digestible crude protein per head per day.

(4) Both the energy and protein requirements of young stock under these conditions are apparently met by a ration, in addition to the natural grazing, of approximately 1½ lbs. of concentrates per day containing 18% digestible crude protein.

Project No. 52.—Urea as a Protein Supplement for Wintering Young Stock.

Object.—With a view to reducing the cost of protein supplements it was considered advisable to determine to what extent urea nitrogen could replace part of the protein nitrogen usually applied in the form of ground nut cake.

Groups—

(*a*) 1 lb. ground nut cake daily plus 1 lb. molasses and 10 lbs. silage.

(*b*) ½ lb. ground nut cake plus 1.3 oz. urea daily plus 1.3 lbs. molasses and 10 lbs. silage.

(*c*) 2.6 ozs. urea daily plus 1.7 lbs. molasses and 10 lbs. silage.

It will be noticed that the urea and ground nut cake were fed together with some molasses and silage. The feeding of the molasses was for the purpose of assisting bacterial conversion of urea nitrogen into amino acids in the digestive tract and to maintain a constant intake of energy, while the nitrogen supplements varied from 1 lb. ground nut cake to ½ lb. ground nut cake and 1.3 ozs. urea to 2.6 ozs. urea only.

Results.—When either the whole or half the protein supplement of ground nut cake was replaced by an equivalent amount of urea in the ration of young Red Poll heifers the weight increase over a period of 93 days was approximately the same as that for the ground nut cake supplement.

A report of this experiment was published in the *Rhodesia Agricultural Journal.*

Project No. 39.—The Effect of Feeding Supplements to Young Growing Steers during the 1st and/or 2nd and/or 3rd Winters after Weaning on their Subsequent Growth and Development.

Object.—In a previous experiment it was found that the feeding of a protein supplement to young steers during their first winter after weaning had little effect on their subsequent development unless the feeding was repeated during the second winter. The object of the present experiment was to obtain more information on this problem.

Groups—

(1) Veld grazing only.

(2) Veld grazing plus protein supplement second winter only.

(3) Veld grazing plus protein supplement first and second winters only.

(4) Veld grazing plus protein supplement first winter only.

(5) Veld grazing plus protein supplement third winter only.

(6) Veld grazing plus protein supplement first, second and third winters.

Results.—This experiment has now been completed and a report is being prepared for publication.

Project No. 58.—The Effect of Wintering Young Steers on Different Planes of Nutrition on their Cost of Production, Growth and Quality.

Object.—In view of the results obtained in a previous experiment it was considered advisable to make a more detailed study of the economics and effect on growth and rate of maturity of wintering young steers on different levels of feeding.

Groups—

First Winter after Weaning.	Second Winter after Weaning.
(1) Control—Veld grazing only.	As first winter.
(2) Veld grazing plus 1-1½ lbs. ground nut cake.	As first winter.
(3) Veld hay *ad. lib.* in pens plus 1-1½ lbs. ground nut cake.	As first winter.
(4) Veld grazing plus 5 lbs. silage, 2 lbs. maize meal, 1 lb. ground nut meal.	Veld hay *ad. lib.* in pens plus 30-35 lbs. silage, 5-6 lbs. cowpea hay. .
(5) Veld hay *ad. lib.* in pens plus 30-35 lbs. silage, 5-6 lbs. cowpea hay.	As first winter.
(6) Veld grazing only.	Veld hay *ad. lib.* in pens plus 30-35 lbs. silage, 5-6 lbs. cowpea hay.
(7) Veld grazing plus 1-1½ lbs. ground nut cake.	Veld hay *ad. lib.* plus 30-35 lbs. silage, 5-6 lbs. cowpea hay.

Results.—A report is now being prepared on the results of this experiment.

Project No. 60.—Urea as a Protein Substitute for Wintering Young Stock.

Object.—To secure more information on the use of urea as a protein supplement for young stock.

Groups.—Seven uniform groups of yearlings were fed daily allowances of 1 to 1½ lbs. each per day of the following mixtures in addition to their grazing during the 1939 winter months:—

Group.	Maize Meal.	Ground Nut Cake.	Blood Meal.	Urea.	Molasses.	Total.
1	1,850	1,000	—	—	150	3,000
2	2,710	—	—	140	150	3,000
3	2,503	—	277	70	150	3,000
4	2,304	300	196	50	150	3,000
5	850	2,000	—	—	150	3,000
6	2,850	—	—	—	150	3,000
7	Control—Veld grazing only.					

Results.—The results to date indicate that urea is not a suitable protein supplement when fed as the sole source of nitrogen. However, when fed in conjunction with small quantities of ground nut cake and/or bloodmeal cattle seem to be able to utilize its nitrogen efficiently. Further work is now in progress to confirm these results.

ANIMAL BREEDING.

Project No. 56.—Cattle Breeding Experiment.

Object.—To obtain information on the effects of the following different breeding systems on the improvement of ranching cattle.

Groups.—A uniform mob of 140 head of ordinary ranching heifers were obtained from the Nuanetsi Ranch. These were divided into four similar groups and each group was bred as follows:—

Group 1.—Continued use of good Africander bulls.

Group 2.—The use of "Crossbred" bulls.

Group 3.—The use of Africander and Hereford bulls in alternate generations, i.e., criss-crossing between the two breeds.

Group 4.—The continued use of good Hereford bulls.

Results.—This experiment has made good progress during the year and below are given the average weights of the first crop of weaners on the 10/11/39, *i.e.*, at the age of about 10 months:—

	No. of Calves.	Average Weight.
Groups 1 and 3 (Africander bulls)	12	318
Group 2 (Crossbred bulls)	12	358
Group 4 (Hereford bulls)	12	327

It is naturally premature to draw conclusions from these data, but they are nevertheless very interesting.

Project No. 57. Cattle Breeding Experiment—Native Cattle.

This experiment, recently commenced, deals with one of the most important problems facing the cattle industry.

Object.—To secure information as to the most suitable breeding policy to follow for the purpose of improving conformation and beefing qualities, without losing the necessary hardiness of native cattle in the Reserves.

Groups.—Three similar groups of typical native heifers are being bred as follows:—

Group 1.—Selected native bulls of good type.

Group 2.—Good type Africander bulls.

Group 3.—Good type "pure-bred crossbred" bulls.

Results.—As the first crop of calves is only now being born no data of any value is yet available.

Project No. 58.—Studies on the Artificial Insemination of Cattle.

Object.—The object is to see to what extent the application of this method of fertilisation can be applied on a practical scale in the Colony.

Results.—Sufficient data are not yet available from which to draw definite conclusions.

Project No. 59.—Factors Affecting the Fertility of Ranch Cows.

Object.—The average percentage calf crop in the Colony is shockingly low, namely, about 50%. A 50% calf crop means that two cows are being run for every calf produced. Our investigations have revealed the following as the main causes of this low percentage of calving:—

(1) The low plane of nutrition of the animals during certain times of the year.

(2) The time of the year the cattle are bred.

(3) The system of running the bulls and cows during the breeding season.

(4) Low proportion of bulls to cows.

(5) The inherited tendency of some females to be "Shy" breeders.

(6) The lack of selection and culling.

(7) Contagious abortion.

Investigations are now in progress to throw more light on these individual factors.

Reproductive hormone therapy as applied under ranching conditions is also being investigated.

Pigs.—Due to the shortage of good type breeding stock in the Colony no pig experiments were carried out as all our experimental sows were used for the purpose of breeding gilts for sale to farmers.

Agronomy.—On the black soil of the farm close on 600 experimental plots were in use. The investigations dealt with:—

(*a*) Maize variety trials.

(*b*) Different crops for grain production.

(*c*) Different crops for ensiling.

(*d*) Maize spacing for grain and silage.

(*e*) Sunflower: spacing for grain and silage.

(*f*) Cowpea spacing trials for hay.

(*g*) Quantitative superphosphate trials.

(*h*) Different fertiliser trials.

(*i*) Rotation experiments.

(*j*) Comparison of different crops for green manuring.

Very valuable information is accumulating and it is hoped to prepare during this year a summary of the results obtained during the past six years.

General Farming.—Rainfall totals during the past eight years were as follows:—

Season.	Rainfall.	Remarks.
1931/32	29.4 inches.	Practically no rain during December and January. Good late rains.
1932/33	14.1 „	The only effective rainfall during December and January. (October .35, November .42, December 4.8, January 7.0, February nil, March .45).
1933/34	19.2 „	Good early rains but drought end January, when maize flowering. No late rains.
1934/35	20.2 „	Good seasonal rains for crops, grass and water supplies.
1935/36	26.9 „	First planting rains 18th December, but after that rainfall satisfactory and good late rains.
1936/37	23.5 „	Best crop season since 1931. Early planting and well distributed rains.
1937/38	13.12 „	Only effective rainfall during December and January. None before or after.
1938/39	36.65 „	The wettest season experienced for many years. In places crops suffered considerably.

Livestock Section.—The following livestock were on hand at the 31st December, 1939:—

Cows regularly milked for dairy purposes	52
Other cows	293
Heifers (over 1 year)	241
Calves (under 1 year)	269
Bulls in use	10
Other bulls	29
Trained oxen	117
Bullocks and untrained oxen	50
Yearlings (oxen and bulls)	75
Total	1,136
Horses	4
Pigs	70

All the cattle did exceedingly well and even came through the winter in first class condition.

Livestock and Livestock-produce produced and sold during the year.

Red Poll bulls sold	5
Red Poll females sold	5
Africander bulls sold	9
Africander females sold	12
Fat stock sold	87
Miscellaneous cattle sold	36
Cattle slaughtered for boys' meat	6
Large White boars sold	5
Large White females sold	8
Large Black boars sold	2
Large Black females sold	20
Baconers sold	37
Porkers sold	6
Old sows sold	1
Gallons of milk produced	19,542
Gallons of milk fed to calves	4,033
Gallons of milk sold	6,189
Gallons of cream sold	69
Gallons of separated milk sold	310
Pounds of butter fat sold	1,713

Farm Section (Crops and General).—From an agricultural point of view the season was rather too wet. In spite of this, however, ample supplies of feed were produced as shown below:—

	1934.	1935.	1936.	1937.	1938.	1939.
Maize (200 lb. bags) ...	797	1,560	1,419	2,135	140	760
Silage (tons)...	300	280	280	190	250	350
Pumpkins (tons)	—	—	—	—	—	—
Majordas (tons).	10	—	—	10	—	—
Veld Hay (tons)...	180	240	240	240	100	500
Legume Hay (tons) ...	40	50	50	75	20	45
Lucern Hay (tons)... ...	14½	5	5	—	3	—
Sunflower head and seed (bags)	—	200	230	100	100	5,000

	1934.	1935.	1936.	1937.	1938.	1939.
Kaffir corn head and seed (bags)	—	38	—	—	20	—
Sunflower seed (bags)...	10	—	10	—	10	—
Ground nuts (bags) ...	—	—	—	—	—	—
Kaffir corn seed (bags)	—	—	—	—	—	—
Legume molasses silage (tons)	—	—	—	—	—	400

No crops of any description were sold in any year.

Water Conservation.—A considerable amount of water conservation work was carried out. Most of the lands were contour ridged and approximately five miles of contour ridges were constructed in the hay lands.

Matopo Dam.—Below are given the minimum and maximum levels of the Dam for the past 10 years. Due to the heavy rains the Dam reached its highest level since 1926, *viz.*, 55 feet.

	Minimum.	Maximum.
1930	42.4 feet	— feet
1931	39.3	44.0
1932	36.5	43.3
1933	28.5	38.4
1934	24.5	33.3
1935	21.5	31.4
1936	32.8	35.8
1937	33.4	38.8
1938	22.0	33.4
1939	30.0	55.1

World's View, Caves, Etc.—Guards were kept at all the places of interest and the surroundings were kept clean. To prevent persons defacing rocks or trees on World's View Farm the whole farm was proclaimed a National Monument. No veld fires occurred in the Park or on farms under our control.

Arboreta.—A considerable amount of work was done in the Arboreta. Large numbers of new trees were planted and dead ones removed. Both Arboreta were maintained in a very attractive condition.

Staff.—At present the staff consists of: C. A. Murray, Senior Animal Husbandry Officer in Charge; W. L. Mackechnie, clerk; T. W. V. Cross, farm foreman and stockman; J. Smit, assistant farm foreman; N. Calder, assistant stockman; A. Mundell, assistant farm foreman; J. A. Clarke, ranger.

Increased calls on their time involved all members of the staff in very hard work which was well executed. To all of them I tender my sincere thanks.

Rhodesia Weather Bureau.

MARCH, 1940.

Station.	Inches.	Normal.	No. of days.
Beitbridge	1.34	1.58	7
Bindura	8.61	4.95	14
Bulawayo	3.76	3.31	13
Chipinga	7.83	7.91	14
Enkeldoorn	3.12	4.03	12
Fort Victoria	3.47	3.62	9
Gwaai Siding	10.52	3.39	17
Gwanda	6.30	3.00	14
Gwelo	6.31	3.39	18
Hartley	4.55	4.35	16
Inyanga	7.53	5.44	18
Marandellas	3.59	5.89	14
Miami	6.73	4.77	17
Mount Darwin	7.81	3.65	12
Mount Nuza	15.68	9.80	24
Mtoko	6.02	3.64	13
New Year's Gift	3.45	3.74	11
Nuanetsi	3.97	2.45	7
Plumtree	6.61	2.82	15
Que Que	4.53	3.89	15
Rusape	3.11	5.06	15
Salisbury	4.81	4.47	15
Shabani	3.10	4.05	13
Sinoia	3.01	4.11	13
Sipolilo	13.30	4.04	18
Stapleford	15.33	11.23	24
Umtali	3.21	5.23	13
Victoria Falls	4.52	3.84	18
Wankie	5.45	3.01	13

Station.	Inches.	Normal.	No. of days.
Abercorn	10.21	—	21
Balovale	5.34	—	20
Broken Hill	7.04	—	20
Chinsali	18.23	—	20
Choma	8.46	—	20
Fort Jameson	9.40	—	20
Isoka	11.41	—	27
Kapiri Mposhi	8.60	—	20
Kasama	12.08	—	25
Kasempa	10.68	—	26
Luangwa	5.84	—	17
Livingstone	6.24	—	19
Lundazi	6.34	—	21
Lusaka	8.65	—	16
Mankoya	7.61	—	17
Mazabuka	5.95	—	14
Mkushi	9.11	—	16
Mongu	11.85	—	17
Mpika	11.85	—	23
Mporokoso	10.09	—	25
Mufulira	12.34	—	19
Mumbwa	7.56	—	18
Mwinilunga	7.64	—	24
Namwala	6.62	—	11
Ndola	10.29	—	23
Sesheke	8.15	—	13
Solwezi	13.38	—	18

MARCH, 1940

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F.														PRESSURE MBS.			Cloud Tenths.	Sunshine hours.
		8.30 a.m.				Maximum.	Minimum.	Max.+Min.÷2.	Absolute.		No. of Days.				Mean of 24 hrs.	8.30 a.m. Station Level.	8.30 a.m 1200 gdm.	Mean of 24 hrs.		
		Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit				Maximum. Date.	Minimum. Date.	Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°						
Beitbridge	1,486	77.6	70.2	67	10.0	89.8	69.9	79.8	100:7	60:27	26	—	27	—	79.0	963.3	882.6	961.3	6.3	—
Bindura	3,700	69.7	66.0	64	4.7	80.9	63.7	72.3	86:1	59:29	1	—	6	—	—	—	—	—	7.0	—
Bulawayo	4,393	67.8	63.7	61	4.8	79.0	60.7	69.8	87:7	54:29	4	—	—	—	68.7	868.9	880.2	867.4	7.2	6.5
Chipinga...	3,685	69.4	65.1	63	5.2	78.3	63.6	71.0	83:27	53:29	—	—	8	—	—	891.9	881.5	—	5.2	—
Enkeldoorn...	4,808	67.6	63.2	61	5.1	78.8	60.0	69.4	85:7	52:29	—	—	—	—	67.7	856.7	880.0	—	4.5	—
Fort Victoria	3,571	70.9	65.4	63	6.7	81.9	62.1	72.0	91:6	53:29	5	2	5	—	70.7	895.3	881.3	891.8	4.8	—
Gwanda...	3,233	71.3	66.0	63	6.6	81.8	63.8	72.8	95:7	56:v.	7	1	12	—	71.3	905.4	880.7	903.7	6.3	—
Gwelo	4,629	67.9	63.9	61	4.6	79.4	60.8	70.1	86:v.	50:29	3	—	—	—	68.3	861.7	880.2	—	5.6	—
Hartley	3,879	70.3	65.2	63+	6.1	81.3	61.9	71.6	87:6	56:29	2	—	1	—	70.2	884.7	880.2	—	5.0	—
Inyanga	5,503	67.8	62.4	59	6.2	73.7	57.1	65.4	77:v.	49:27	—	3	—	—	—	—	—	—	5.2	—
Marandellas	5,453	65.5	61.4	59	4.6	74.7	57.2	66.0	81:5	53:27	—	2	—	—	64.3	—	—	—	4.9	—
Miami	4,090	68.1	65.6	64	3.0	78.1	62.5	70.3	83:4	57:29	—	—	—	—	68.4	877.7	879.7	876.1	7.1	—
Mt. Darwin...	3,179	71.0	66.7	65	5.5	71.1	65.2	73.1	85:2	60:28	—	—	13	—	—	—	—	—	6.8	—
Mount Nuza	6,668	58.2	56.8	56	1.3	64.0	53.9	58.9	68:6	48:27	—	31	—	—	58.4	801.4	880.5	—	7.9	—
Mtoko...	4,136	68.9	64.4	62	5.3	78.0	62.1	70.0	82:v.	58:27	—	—	1	—	69.0	877.0	880.6	875.7	5.7	—
New Year's Gift ...	2,690	72.0	67.5	65	5.7	83.6	62.7	73.2	89:5	54:29	7	—	9	—	—	—	—	—	—	7.0
Nuanetsi	1,547	74.6	70.2	68	6.0	88.3	66.7	77.5	100:9	57:30	22	—	22	—	—	961.1	881.5	—	6.3	—
Que Que...	3,999	69.6	65.4	63	5.1	81.9	61.8	71.9	88:7	54:29	4	—	3	—	70.8	881.2	880.4	879.5	5.0	—
Rusape	4,648	67.2	62.9	60	5.0	78.4	59.3	68.9	85:5	52:28	—	—	—	—	67.3	—	—	—	5.0	—
Salisbury	4,831	67.5	63.0	60	5.2	78.0	59.3	68.7	82:6	54:18	—	—	—	—	67.6	885.5	880.1	854.1	6.6	6.7
Sinoia	3,795	71.1	66.7	65	5.5	81.5	62.5	72.0	86:6	56:29	2	—	3	—	—	—	—	—	5.6	—

MARCH, 1940 (continued)

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F. 8.30 a.m. Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min.÷2.	Absolute. Maximum Date.	Minimum Date.	No. of Days. Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hrs.	PRESSURE MBS. 8.30 a.m. Station Level.	1200 gdm. 8.30 a.m	Mean of 24 hrs	Cloud Tenths.	Sunshine hours.
Stapleford	5,304	63.1	60.6	59	2.7	70.2	56.4	63.3	75:6	46:28	—	9	—	—	62.9	—	—	—	6.4	—
Umtali	3,672	69.3	66.0	64	4.1	80.5	63.3	71.9	87:4	57:28	3	—	6	—	69.9	892.0	881.1	890.5	5.4	7.7
Wankie	2,569	73.8	69.8	68	5.3	88.6	68.5	78.6	97:v.	65:27	22	—	30	—	68.9	925.8	880.0	—	5.8	—
Abercorn	5,458	64.7	62.3	61	2.6	73.9	58.8	66.4	79:30	57:v.	—	—	—	—	64.6	837.8	880.6	—	8.0	—
Broken Hill	3,911	68.2	65.9	65	2.9	78.7	62.8	70.7	84:3	60:27	—	—	—	—	68.9	883.4	879.6	—	8.3	—
Fort Jameson... ...	3,815	70.3	66.4	65	4.7	79.9	64.6	72.2	84:14	63:v.	—	—	3	—	70.3	887.1	880.8	885.4	6.6	—
Fort Roseberry ...	3,830	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kalomo	—	69.0	65.8	64	3.9	79.6	62.1	70.8	85:6	55:30	—	1	—	—	69.2	876.5	879.2	—	5.8	—
Kasama	—	66.0	63.9	63	2.4	77.5	62.0	69.8	81:9	59:11	—	—	—	—	67.5	863.8	880.2	862.1	7.9	—
Kasempa...	4,500	64.5	63.2	63	1.3	77.5	60.7	69.1	82:23	54:28	—	—	—	—	—	—	—	—	—	—
Livingstone...	3,051	71.6	68.0	66	4.8	84.2	65.2	74.7	91:4	60:30	14	—	22	—	72.9	906.8	879.5	905.0	6.4	6.6
Luangwa Bridge ...	1,330	74.6	72.3	71	3.1	87.1	71.2	79.2	93:3	67:26	24	—	31	—	77.5	—	—	—	—	—
Lundazi	3,590	68.8	66.7	65	2.6	78.8	63.5	71.1	82:v.	59:v.	—	—	4	—	69.2	—	—	—	—	—
Lusaka	4,193	67.6	65.3	64	2.8	77.2	62.5	69.9	81:7	57:27	—	1	1	—	—	874.2	879.5	—	8.1	—
Mongu	3,481	72.1	67.6	65	5.8	82.7	66.0	74.3	87:29	63:27	5	—	17	—	73.3	896.0	879.1	874.3	5.6	—
Mpika	4,620	65.9	64.2	63	1.9	76.4	61.8	69.1	81:9	59:21	—	—	—	—	67.3	861.9	880.7	—	8.5	—
Msoro	3,000	73.0	70.5	69	3.3	85.1	67.2	76.2	90:4	58:25	7	—	24	—	73.5	—	—	—	—	—
Mumbwa...	3,500	68.1	65.5	64	3.1	80.5	65.3	72.9	85:6	58:27	—	—	21	—	71.4	—	—	—	—	—
Mwinilunga...	4,450	67.9	65.8	64	2.5	77.4	61.1	69.3	82:31	60:v	—	—	—	—	—	—	—	—	—	—
Ndola	4,190	66.9	65.2	64	2.0	78.9	62.6	70.8	85:2	60:27	—	—	1	—	69.0	874.9	879.9	—	8.2	—
Chileka	2,600	73.7	68.9	67	6.3	81.6	66.8	74.2	84:v.	64:18	—	—	26	—	73.0	927.0	881.2	—	5.2	—

Rainfall in March, 1940, in Hundredths of an Inch. Telegraphic Reports.

Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	Normal
1	1	...	...	...	10	2	...	49	29	9	1	1	26	10	54	107	5	1	2	56	17	18	2	7	1	...	...	...	...	...	22	430	322
2	...	4	...	...	...	...	...	137	72	31	25	10	30	2	1	1	...	...	...	4	...	...	35	18	78	...	...	...	..	...	...	448	606
3	13	...	...	35	...	2	3	115	32	63	50	124	6	...	1	...	6	...	1	13	...	...	9	36	73	1	...	...	...	...	42	625	803
4	...	...	...	...	...	2	25	87	13	34	6	11	104	40	51	58	1	...	10	45	21	8	31	14	18	...	...	...	...	...	...	579	503
5	6	...	...	...	...	2	7	61	54	8	10	45	33	36	141	25	15	13	2	39	20	1	14	10	...	...	...	...	...	...	11	553	297
6	...	...	...	...	21	...	45	48	29	35	4	26	37	1	6	7	1	11	...	4	26	75	25	31	...	1	...	...	...	6	5	444	471
7	3	...	6	...	2	2	71	16	6	30	28	52	33	2	...	36	5	1	1	10	28	44	33	...	5	...	..	...	...	17	4	435	592
8	19	13	10	30	20	10	101	158	9	40	15	15	48	19	1	...	2	...	...	...	57	98	82	24	20	6	1	...	...	13	6	817	519
9	27	2	1	15	4	7	51	142	32	32	13	5	40	5	...	8	3	...	...	...	42	22	47	55	...	...	2	...	...	...	...	544	451
10	...	51	73	...	...	...	67	104	20	19	45	19	62	...	13	1	...	...	..	...	9	141	67	...	...	...	...	...	...	...	...	691	364
Mean	6	4	5	3	6	2	29	81	35	22	14	22	40	13	39	34	5	4	2	22	22	30	28	18	13	...	...	...	...	3	7	509	443

Southern Rhodesia Veterinary Report.

MARCH, 1940.

DISEASES.

Anthrax was diagnosed at Magudu's in the Chibi native district. Mortality one head.

TUBERCULIN TEST.

Ten bulls were tested on importation. One cow, which showed a suspicious reaction last month, was re-tested. There were no reactions.

MALLEIN TEST.

Four horses were tested with negative results.

IMPORTATIONS.

From Union of South Africa: Bulls 19, horses 4, pigs 5, sheep 605.

From Bechuanaland Protectorate: Sheep 459.

EXPORTATIONS.

To Portuguese East Africa: Oxen 14.

To Northern Rhodesia: Sheep 42.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

To United Kingdom: Beef quarters (chilled quality), 8,390; boneless beef quarters, 330; tongues, 14,088 lbs.; livers, 36,682 lbs.; hearts, 12,432 lbs.; tails, 7,255 lbs.; skirts, 904 lbs.; shanks, 4,981 lbs.; cheeks, 57 lbs.; fillets 49 lbs.

To Northern Rhodesia: Beef carcases, 131; offal, 11,047 lbs.

To Belgian Congo: Beef carcases, 76; mutton carcases, 18; offal, 227 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa: Corned beef, 27,136 lbs.; beef fat, 16,000 lbs.; beef paste, 10,848 lbs.; sausages, 1,745 lbs.

To Northern Rhodesia: Meat meal, 2,660 lbs.

B. A. MYHILL,
Chief Veterinary Surgeon.

THE RHODESIA

Agricultural Journal

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Honey Stimulates the Rooting of Cuttings.—According to a report in the Canadian *Scientific Agriculture,* honey was found to stimulate the rooting of cuttings of several kinds, including chrysanthemum. The best treatment was to stand the cuttings in a 25 per cent. solution of honey for 24 hours before planting. The response to this treatment was only very slightly less than that obtained from the most favourable hormone treatments. It has not yet been determined what is the active substance in honey, but the results indicate that where large numbers of rooted cuttings are required this treatment is worth testing.

Compost. New York Forestry Service.—According to Bulletin 22 of "Notes on Forestry Investigations," compost was used on the plots prepared for transplanting forest trees in New York State. The compost was made of combinations of manure, leaves, soil and superphosphate and was used two years after manufacture. It was applied at the rate of 10 tons and 20 tons per acre and each treatment was applied to four plots with two untreated plots as controls. Using weed growth as an indicator of soil fertility it was shown that, for the two years following treatment, the 10-ton rate and the 20-ton rate produced ten and twenty times, respectively, the weight of weeds produced by the control. The compost was effective for at least three growing seasons.

Agricultural Show Dates.—The following are the dates which have been fixed for the 1940 Agricultural Shows:—

Bindura—July 27th.

Umtali—August 23rd and 24th.

Gwelo (National Jubilee Show)—August 29th and 30th.

Dahlias and "Kromnek."—Three Government Notices in connection with dahlias and their threat to tobacco growers have been published recently under different Acts and Ordinances.

Government Notice No. 162 of 1940 under the Importation of Plants Regulation Ordinance, 1904, prohibits the introduction into Southern Rhodesia of any dahlia plants or tubers from the Union of South Africa, because the majority of dahlia plants there are believed to be infected with the virus causing "Kromnek" in tobacco plants.

Government Notice No. 236 of 1940, under the Tobacco Pest Suppression Act, 1933, declares this virus to be a pest within the meaning of the Act, thus placing "Kromnek" disease on a par with tobacco leaf-curl. It also declares dahlia to be an alternate host of the virus. The effect of this is that, although the growing of dahlias at any time of the year on portions of farms other than those upon which tobacco is growing is not prohibited, an Inspector has the power to order the destruction of dahlias. This power will, of course, be used only when the plants are infected, or threatened by or suspected of infection.

Government Notice No. 237 of 1940, under the Nurseries Ordinance, 1909, declares the virus to be a pest, and thus makes it possible to quarantine or destroy dahlias in registered nurseries.

Details of the disease and of its appearance are published by the Senior Plant Pathologist in this issue.

Cleanliness Aids Insect Control.—Comprehensive hints on Agricultural Cleanliness for this month were published in the June number of the *Journal* last year, and, in order to avoid any suggestion of staleness in these columns, will not be repeated here. But they should be referred to by all those progressive farmers who have the best interests of their farms at heart. Back copies of the *Journal* are apparently accumulated by such farmers. This became evident when, in last October's number, a copy of each of the January and February numbers was advertised for. Only one copy of each was forthcoming, and these were soiled copies kindly given by the printers. Subscribers evidently wished to keep theirs. Let it be a challenge to the good intentions of those who keep their back numbers whether they refresh their memories by referring to these columns of last year.

Pastures and Nitrogen.—A report on the investigation of the nitrogen requirements of pastures in Natal published some time ago by Mr. W. B. Goldschmidt indicates that the rapid decline in production of pasture land some three years after establishment is directly correlated with the available nitrogen supply in the soil. An acre of good *Paspalum dilatatum* or an acre of moderately good *Pennisetum clandestinum* (Kikuyu) grass land is capable of removing nitrogen in amounts equivalent to 800 lbs. or more of ammonium sulphate per acre per annum.

The rate of uptake of ammonium sulphate by *Paspalum* is extremely rapid. An application of 800 lbs. of ammonium sulphate per acre was taken up in seven weeks, so that no residual nitrogen from the ammonium sulphate could be demonstrated in the soil. The rate of assimilation of Kikuyu grass land was even more rapid.

Three possible methods of maintaining a favourable nitrogen balance in pasture soils are suggested:—(*a*) The introduction of a suitable pasture legume inoculated with an efficient nitrogen fixing strain of bacteria. (*b*) Employing a suitable system of rotational cropping. This is under investigation at present. (*c*) Cultivation of the growing pasture grass.

Farming Calendar

JULY.

FORESTRY.

Care should be taken to protect all plantations from fire by hoeing belts round them and burning any grass likely to be dangerous. Cuttings of various deciduous trees may be taken and struck in nurseries. Continue pricking out conifers into tins or beds. In preparation for early planting in case the season is favourable, limited sowings of eucalypt seeds may be carried out. If labour is available, preparation of land for planting to be taken in hand.

CROPS.

Support agricultural shows, and add to your list of exhibits. Advertise your goods through the shows. Interested people will see them. If you require to make purchases of seed for next season, judge by the exhibits on the show what grower can best supply your needs, and place your orders accordingly. Attend the shows and go there to learn all you can about your business. Seed maize previously selected in the field should be butted and tipped and hand shelled. Keep the butt and tip grain for check row planting by hand. Do not over-irrigate winter crops, and do not irrigate when the wind is from the south, as this often means frost at this time of year. Troublesome weeds, such as darnel grass or drabok, may be removed from cereal crops by hand. Ploughing should be pressed on with, and maize stalks and roots of maize and other trash from the crop should be collected and burned or composted. A land littered with unburnt and unrotted stalks and roots cannot be brought to a suitable tilth for planting and subsequent cultivation. Silage and sweet potatoes and other succulent feeds will have come into general use now, the potatoes being lifted from the land as required. The application of phosphatic fertilisers which are to be ploughed or harrowed in can be begun. Take the opportunity, during this and the next month or two, of inspecting all boundary and paddock fencing and gates, and effect repairs where required. Give a coat of paint to implements, wagons and carts. This protects the woodwork from rotting and iron from rust. If not already marketed, the main potato crop will probably be sold about now.

STOCK.

Cattle.—The bulls may again be put into the herd at the end of the month. Watch for any unthrifty cattle and get them into the home paddock and feed them before they become really poor. The value of a good provision for winter feed will be apparent now. Except under purely ranching conditions winter feeding should be general. Where areas have been properly reserved for winter grazing these should be in use now. Generally the treatment of the dairy herd should be continued on the same lines as in June.

This is one of the coldest months of the year, and milk production as a rule is low. Those cows which are being milked should receive a full winter ration of succulents (ensilage, pumpkins or majordas) and hay.

Sheep.—As for June, where necessary dose for hookworm.

DAIRYING.

No difficulty should be experienced in producing first-grade cream at this time. In cold, windy weather due precautions should be taken to ensure that the milk when separated is not below 90 degrees.

Most cheese-makers cease their cheese-making operations at the end of the month, as milk is usually scarce. Cheese in the store-room should be carefully watched, as cheese mite is likely to appear on old mature cheese. In order to prevent the undue drying out of the cheese, the floor of the cheese room should be sprayed with water from a watering can.

VEGETABLE GARDEN.

Sow turnips, peas, cabbage, beet, carrots, parsnips, radishes, lettuce and spinach.

POULTRY.

With the cold weather that we generally have in July, the birds should have extra food, *i.e.*, barley or maize, if the supply of eggs is to be continued. A mixture of stewed linseed and bran should be given to the birds, warm, the last thing before they go to roost. This gives them a little extra food during the long and cold hours of the night at this time of the year and maintains the body heat. A certain amount of shelter is also necessary to protect them from the cold winds. Grass wind breaks about 3 feet high on the windward side of the run are sufficient. Remember that no chickens should be hatched after August; those hatched later take much longer to develop than those hatched before August, and they are usually stunted, weakly and unprofitable. Each month the young stock should be gone through and graded; anything that does not promise to be good should be got rid of. As the hatching season draws to a close, the breeding stock, if not carefully watched and treated, will become run down, and infertile eggs and weak chicks will be the result. Watch the breeding stock carefully and handle them occasionally; if they feel thin and light or the flesh is not hard but flabby, give extra food and more scratching exercise. The male especially should be well looked after and given a meal on three or four days of each week by himself; in addition, he should have some raw meat as often as possible. Good hatching and strong, healthy chicks are wanted right up to the end.

Turkeys should now be in full lay. Never disturb the hens when they are sitting. They are very sensitive and nervous, and unless left mainly to themselves, are apt to desert the eggs or break them. It is recommended that turkey chicks be reared by hand; the hens are poor mothers, they are clumsy, drag their chicks all over the place, and do not feed them as well as an ordinary hen does. The main thing is to keep the young turkeys warm, give then plenty of fresh air, thick separated milk and chopped onions or onion tops.

VETERINARY.

Horse-sickness and blue tongue should now have disappeared. Redwater and gallsickness occur all the year round, but the worst time is during the summer, when ticks are prevalent. Sheep may be inoculated against blue tongue now. Scab in sheep will probably be in evidence this month.

The Feeding of Molasses to Poultry

By A. H. Gericke, Poultry Research Officer, College of Agriculture, Potchefstroom.

Molasses is a feed that is most valuable as an energy concentrate. Sometimes it contains as much as 48 per cent. of sugar and 12 per cent. of carbohydrates other than sugars, but it is low in proteins and contains no fat or fibre. Cane molasses is cheap, it is palatable, it has a laxative effect and has the added advantage of reducing the dustiness of a ration. For these reasons it has became popular as a stock-feed.

Few experiments have been conducted with cane molasses as a feed for poultry. Winter (1929) stated that cane molasses may be used to replace cereal grains pound for pound up to 12 per cent. of poultry rations. Bice (1933) reported that cane molasses, when fed in amounts not exceeding 7 per cent. of the mash ration, was a satisfactory feed for chicks and for growing pullets and cockerels. Upp (1937) again recommended that not more than 5 to 7 per cent. molasses should be used in chick rations. In general, it can be accepted that molasses should not exceed 5 per cent. of the poultry ration.

Cane molasses is difficult to mix in poultry dry-mash rations as it is sticky, and in some countries overseas dehydrated molasses is mixed in the mash ration. Four pounds of dehydrated molasses is equivalent to five pounds of liquid molasses.

At Potchefstroom molasses is fed in the wet mash and not in the dry mash of laying hens. Molasses mixes readily with water and the viscosity is reduced. Half a pound of liquid molasses is mixed with one gallon of water. This mixture is then used for mixing the dry mash.

The consistency of the wet mash should be crumbly and not sloppy. In winter the wet mash can be given every morning. It stimulates the appetite of birds, especially of pullets, and egg production is increased.

Molasses can also be given in the drinking water in the same proportion as stated above, but if it is included in the wet mash the birds should receive clean drinking water. If molasses is mixed in the drinking water, it should be given on *alternate days only*. If given in the drinking water every day, the best results will not be obtained, for the birds become too thirsty and go off their feed. If clean drinking water is given in between, the birds satisfy their thirst and excellent results are secured.

Molasses acts as a mild laxative, causes increased water consumption and contributes towards the health and well-being of poultry.

Not long ago it was discovered by California workers that cane molasses is a rich source of a new vitamin which has not yet been named. It is known that the presence of this vitamin in poultry rations preserves the health of the skin and spinal cord. It prevents scab formation around the eyelids of chicks, the corners of the beak and around the vent. It also prevents thickening of the skin on the bottom of the feet. This vitamin is also found in milk by-products, yeast, lucerne meal and green grass.

Even if this vitamin may not be deficient in ordinary rations, it is as well to know that cane molasses is a rich and cheap source.

Molasses should perhaps be used to a greater extent in the rations of cockerels fed for marketing purposes. By making the ration more palatable better conditioned birds should be available for marketing.—(Union of S.A. Press Service.)

Mycological Notes.

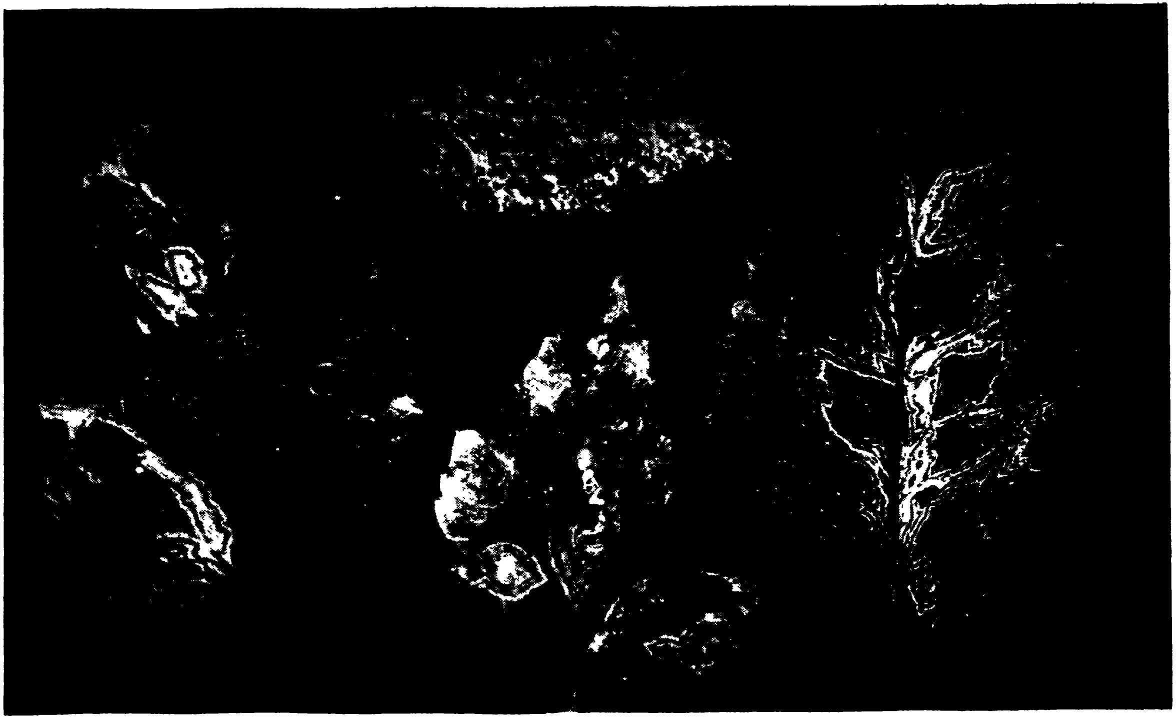
15. THE TOBACCO "KROMNEK" VIRUS IN RHODESIA.

By J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

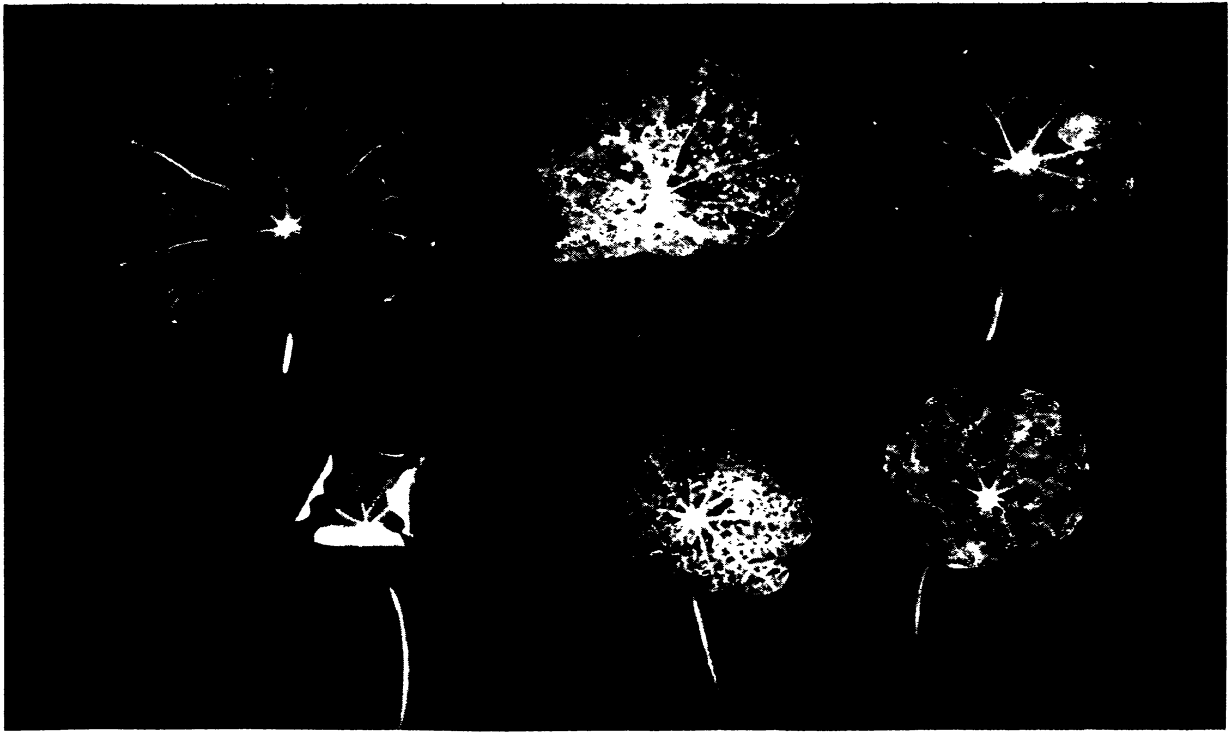
A serious disease of tobacco in the Union called "Kromnek" has been known in the East Cape Province for a long time. In recent years the cause of the disease has been proved to be a virus and it has been shown that plants other than tobacco can become infected by it. The number of alternate host plants known to be susceptible is large and new names are being constantly added to the list. An incomplete list, kindly supplied by the Union Department of Agriculture, of plants naturally infected by the kromnek virus in South Africa includes Aster, Dahlia, Zinnia, Nasturtium, Tomato, Tobacco, Potato, Stinkblaar (Stramonium), various species of Solanum, Gaillardia, Pentstemon, Campanula, Chrysanthemum, Iceland Poppy, Phlox, Black Jack, Coreopsis, Senecio, Arum Lily, and others. It does not mean that these plants necessarily carry the disease in Rhodesia, but they would be susceptible to infection should kromnek be introduced to the locality where they are growing.

A short while ago dahlias showing symptoms of the disease were observed in Bulawayo, and following this discovery infected nasturtiums and tomatoes were found growing nearby. Further inspection revealed the disease in a few isolated dahlia and nasturtium plants in Salisbury. No other evidence of the presence of the kromnek virus in Rhodesia has been found and the Department of Agriculture is taking steps to prevent the spread of the disease to other parts of the Colony, more especially the tobacco growing areas.

It is thought that the virus has been introduced in dahlia tubers imported from the Union. Regulations have been



Characteristic markings caused by the Kromnek virus on dahlia leaves. The line patterns should not be confused with the common circular, brown leaf spot, which is caused by a fungus



Symptoms of Kromnek in nasturtium. Not to be confused with those caused by mildew or leaf miner.

gazetted prohibiting their further importation and empowering the Government to take suitable action to prevent the spread of the disease to tobacco farms. A note on these regulations is included in this issue of the *Rhodesia Agricultural Journal.*

The disease has not been reported in tobacco in Rhodesia, although several suspected cases have been investigated during the past seven or eight years. The symptoms on tobacco are in some respects similar to those of rosette. For instance, the characteristic bending over of the stalk and bud leaves, which gives the name "kromnek" to the disease, is also encountered in some phases of rosette. Similarly, a puckering of the leaf blade along the midrib and a kinking of the midrib itself are symptoms of both kromnek and rosette, whilst the former abnormality is also associated with lightning damage. The disease, therefore, really requires expert diagnosis, but despite constant vigilence and several false alarms, the true kromnek cannot be said to have been seen on tobacco in the Colony.

This preliminary note is in the nature of a warning to tobacco growers, and photographs are published of the symptoms of the virus on the leaves of dahlias and nasturtium, host plants on which the disease has been definitely diagnosed in Rhodesia.

Symptoms on most other host plants are similar to those on dahlia, that is the formation of diamond, concentric ring and wavy line patterns on the leaves. These patterns on dahlia are usually yellowish at first and as the plant ages the lines become more defined, turn brown and often white, but are never quite as distinct as they appear in the illustration. Sometimes the lines form no definite shape or they may follow the outlines of the veins producing a "fern-leaf" pattern.

On nasturtium the most easily recognised symptom is the appearance of pale green, yellowish or whitish areas, which follow the veins forming an indefinite pattern as seen in the illustration. At other times dark and pale green mottling and blotching may appear. Somewhat similar symptoms may occur in the early stages of mildew infection, but they can be distinguished from those of kromnek by the presence of small, angular, powdery white patches on the *lower* surface of the leaf. The marks left by the leaf miner may also bear a superficial resemblance to knomnek symptoms, but the former have no relation to the vein pattern and being translucent can easily be distinguished from the latter.

On tomatoes the ring patterns rarely appear. The most characteristic symptoms are the rolling inwards of the margins of young leaflets, bringing into prominence the purple colour of the under surfaces. Older leaves develop a marked bronzing having no apparent relation to the veins. The streaks have an irregular branching form and may develop into a scorch which causes the leaflet to shrivel and die. Affected plants are stunted and bunched at the top and may be confused with those infected by the bunchy top virus, which is, however, a distinct disease. Fruits from plants affected by the kromnek virus are usually small in size and may show concentric ring patterns. Plants grown in the shade may appear to be quite normal and generally produce a fair crop.

All these symptoms on tomato have not been observed in Rhodesia, the descriptions having been abstracted from the Union Department of Agriculture *Science Bulletin* 123, by Dr. E. S. Moore, published in 1933.

The disease has been shown in the Union to be transmitted from diseased to healthy plants by a small thrips, *Frankliniella* sp., and it is presumed that natural spread occurs by this means. From the Rhodesian point of view, however, the most dangerous and likely method of spread is by means of tubers, bulbs, cuttings and seedlings. The kromnek virus, as with other viruses such as rosette, is present in the sap of infected plants so that all vegetative parts of such plants, which are taken away for propagation, are also infected and the disease will develop as the plants grow.

It is known that the kromnek virus is not seed-borne, so that if susceptible host plants are to be grown on a tobacco farm, they should be raised from seed on the site and not brought in as cuttings, bulbs or seedlings. Enthusiastic dahlia growers can derive much pleasure from raising new varieties from seed, with the consolation, if consolation is necessary, of knowing that they are assisting in preventing the introduction to the Colony of yet another serious tobacco disease.

All farmers and gardeners, but particularly tobacco growers, are strongly advised to examine their crops and garden plants closely for any symptoms suggestive of ring, diamond or line patterns, and to make a thorough scrutiny of dahlia plants, especially if the tubers have been imported from the Union. Any suspicious plants should be uprooted, pressed between newspaper, and despatched "O.H.M.S." to the **Senior Plant Pathologist, P.O. Box 387, Salisbury.** If labelled "Natural History Specimens" they may be sent post free.

A fuller description of the kromnek virus disease will be published at a later date.

Agricultural Cleanliness,
Field Sanitation,
Agricultural Hygiene,
Phytosanitary Methods—
Call it what you like, but
CLEANLINESS AIDS INSECT CONTROL.

Soil and Water Conservation.

PART IV.

PREVENTION AND CONTROL OF GULLIES.

By D. AYLEN and the Irrigation Officers.

DAMAGE DONE BY GULLIES.

Gullies are usually looked on as only doing damage in the actual area occupied by the gully; moreover, their rate of growth is always seriously under-estimated. Besides the downward cutting, deep gullies rapidly extend uphill by head erosion and many lateral gullies usually form from the sides taking in an ever-increasing area.

Farmers have regarded the formation of gullies as inevitable and usually do not express concern until such a number have been formed as to seriously inconvenience transport on the farm. Gullies, however, are preventable. Wiser planning of the farm would have prevented most gullies, others need not have been caused if a comparatively small amount of protective work had been undertaken at the commencement.

Owing to a reckless disregard as to the results or through ignorance, many natural watercourses and centres of vleis have come under the plough, roads and cattle tracks have been made without heed of the consequences and narrow unprotected drains have been made on too steep a grade.

Until a farmer has had experience of gullies he is apt to regard them as nothing more than obstructions, and considers that the prevention or cure in the early stages would only be throwing money away, or mean neglecting other opportunities for developing the farm. He is not convinced of the economic necessity for control in the early stages and would far rather spend his time in development work which brings in some cash return.

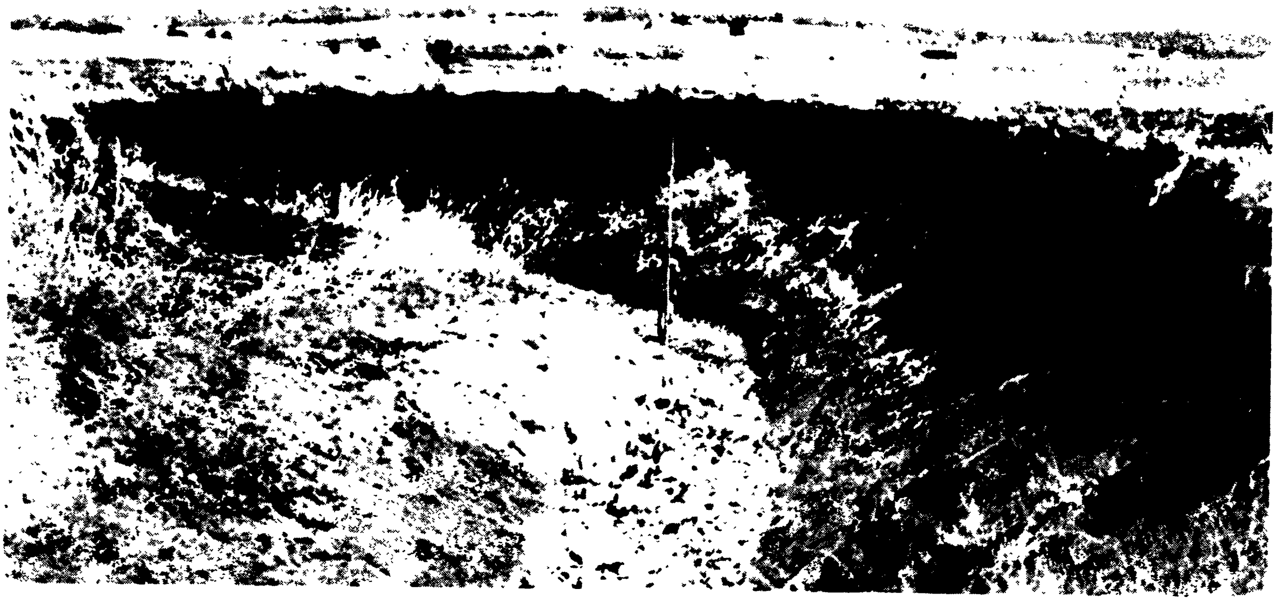


Fig. No. 1.—The ploughing up of a natural waterway resulted in the formation of this huge Mazoe Valley gully.

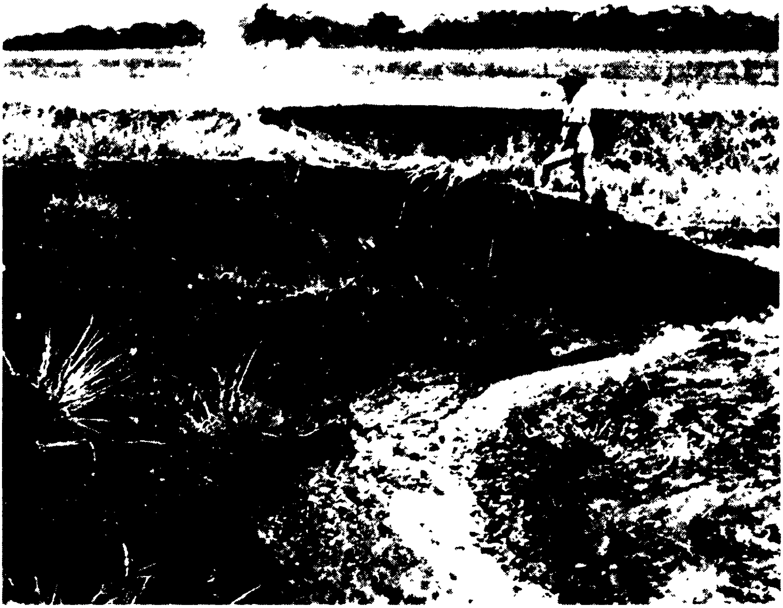


Fig. No. 2.—Temporary brush checks and grass planting would control this shallow gully.

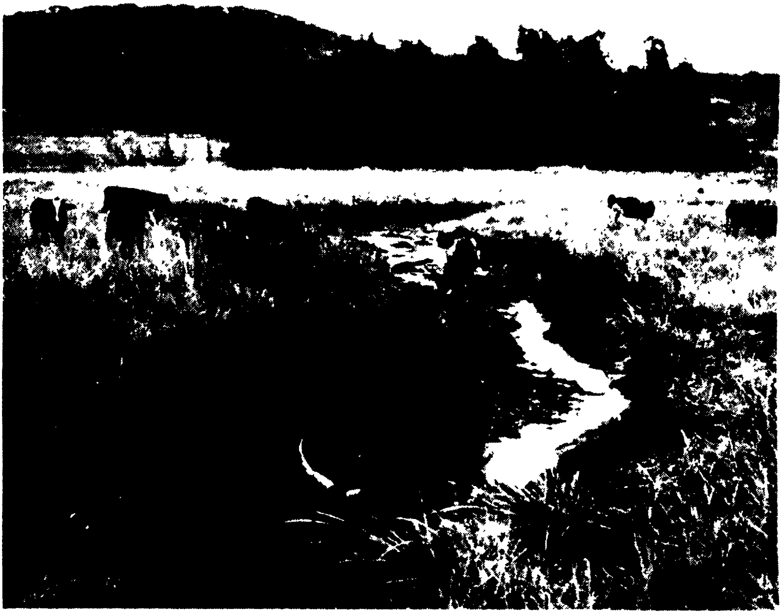


Fig. No. 3.—The natural grass plus a minimum of attention would heal many similar gullies—*if cattle were kept out.*

Gullies are more than just mere obstructions whose increase in size and inconvenience greatly outgrows expectations. They make future soil conservation works much more difficult to plan, and every place at which it is desired to empty water into them is a danger point at which a new gully will form unless costly measures are taken to prevent this. During storms the rain water finds its way to a gully and is rapidly drained off and increases the intensities of floods below. In many areas the major part of the silt which is finding its way into rivers comes from gullies. In addition to increasing the rate of flood run-off, gullies are one of the major causes of reduced yields from springs and the drying out of vleis, as they lower the general underground water level over considerable areas by the continued seepage into them of water which has penetrated into the soil and would normally be retained there if gullies did not drain it off.

Only too late is it found that the damage and obstruction caused by the gullies can so handicap farming as to make it impossible to reach the happy financial stage when gully control can easily be afforded.

By the time the farmer is convinced of his early mistake the gullies may have reached such proportions as to make their control tiresome and costly, or even beyond his powers.

Unfortunately, the largest gullies and the most difficult to control are usually through a cultivated land in the natural valley or down the boundary fence, and often it is essential that they be kept in use for drainage purposes. Such gullies have, as a rule, almost vertical banks and the soil is relatively soft to a considerable depth. The formation of many of these gullies could have been prevented if the danger of ploughing across hollows had only been realised sooner.

The prevention of erosion in steep graded narrow boundary drains is often a costly problem and in many instances their erosion to fearsome gullies has unfortunately been accepted as inevitable.

The deterrent factor is the initial cost from which no return can be expected, and many farmers believe themselves unable to spend any money on development work unless it produces an immediate return. It should, however, be realised that the cost of preventing erosion in the early stages is only a fraction of the cost of control if large gullies have been allowed to develop, and delay in control may cause sufficient damage to seriously affect the earning capacity of the farm.

In the case of boundary drains the preventative measures are simple and cheap, comprising merely the construction of a broad shallow drain protected with a growth of thick low grass prior to use and possibly a few bolsters. The objection to the width of these drains, which may be as much as 50 feet, is easily over-ruled by the fact that that once a gully is formed a far wider strip has to be left out of cultivation.

PRINCIPLES OF GULLY PREVENTION.

Natural water courses do not erode until the vegetative cover is damaged, or the peak intensities of floods have been greatly increased by the removal of natural cover from the lands above. Vegetation not only greatly reduces the speed of the flow but also forms a protective coat, whilst the roots bind the soil. Overgrazing and veld fires by removing this protective covering can therefore often be blamed as the cause of many new gullies in the veld. Even with careful treatment cover is bound to be reduced as farms become stocked, so it is most important to see that the cover in water-courses is not disturbed.

Before erosion can take place water must attain a certain velocity, and the velocity depends on not only the depth of the water but on the slope of the land and the resistance offered by vegetation. Soil covered by thick grass can withstand a very much higher velocity than bare soil.

This gives us the clues to gully prevention and control, which are:—

(*a*) Reduction in the volume of run-off by maintaining a good cover in the veld and generally taking measures to increase absorption of water.

(*b*) Planning all works so that the gathering time of the flood water is increased. (The peak intensities of floods are reduced if the time is prolonged.)

(*c*) Maintenance of thick cover in all natural valleys and hollows.

(*d*) Keep cattle and fire out of gullies and places likely to become gullies.

(*e*) Plan all roads and tracks as far as possible to avoid damage and keep the number of cattle tracks as small as possible by adequate fencing and drinking places and dip tanks.

(*f*) Planning and construction of all drainage works so that they do not erode nor cause undue concentration of water.

(*g*) Planning and construction of all soil conservation works so that the water is delivered to suitable places and in such a manner that erosion will not be caused.

The adoption of these measures throughout an area drained by a stream is known as " catchment area planning," and in the few examples we have available in this Colony of the complete protection of small catchment areas, it is found that the intensities of floods have been reduced to a fraction of those formerly experienced, and that the water running off contains only a small percentage of silt.

With regard to (*a*), this involves the prevention of over-grazing by paddocks, the improvement of the veld cover by mowing, prevention of uncontrolled veld fires, and the construction of contour ridges on all cultivated land. The effect of the destruction of herbage, the formation of gullies and the return to normal conditions by closing the gullies and restoring the natural cover is well illustrated by the following example.

In one of the Reserves a dip tank was located close to a permanent spring, and the ground in its vicinity, which was formerly covered by thick grass, was trampled out and soon became severely gullied. As a consequence the spring ceased to flow. The area was then fenced off and protected by a fireguard, the gullies were filled with loose stones and small earth check dams constructed across the dry stream bed.

In the following year the flow from the spring re-appeared and sufficient water now reached the check dams to serve large numbers of stock.

With regard to (*b*), this involves the construction of small check dams across all gullies to reduce the velocity of the water running in them, the construction of simple diversion works to spread water over the veld from farm roads, footpaths and cattle tracks, and in general the adoption of all measures which will cause the flood water to take as devious a route as possible before it escapes to the nearest stream channel. Contour ridges and drains should flow in the reverse direction to the general fall of the valley. By this means the water is worked back and delivered at the central channel and the time taken for water to reach the lower end of the catchment area is prolonged.

With regard to (*c*), this involves refraining from cultivating all natural hollows and depressions and instead utilising them for the passage of flood water. The advantages of maintaining an adequate grass cover in these depressions are obvious, as not only is the danger of them eroding into gullies prevented, but the velocity of the water is also appreciably reduced and the gathering time of the catchment thereby increased.

With regard to (*d*), this may involve fencing off of large gullies and the construction of fireguards to prevent the ingress of fire.

With regard to (*e*), this involves the aligning of all roads and tracks as far as possible on the contour and the construction of suitable drains to prevent the road becoming a channel for the passage of flood water.

With regard to (*f*), this involves the construction of all drains on a reasonably flat grade, or if this is not possible the construction of checks, bolsters or properly protected drops at intervals to prevent the water attaining such a velocity that erosion will occur.

In addition the drains should be made of the wide dished type and the growth of low growing grass encouraged, as if this is done the grade may be safely increased without the necessity for constructing bolsters or drops.

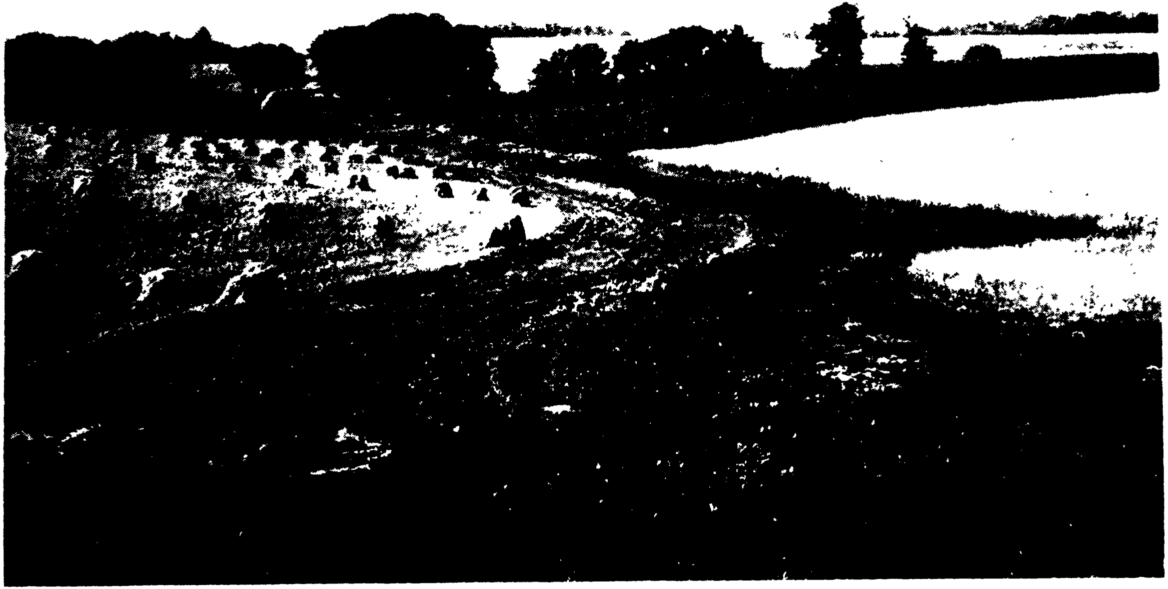


Fig. No. 8.—Natural hollows should be planted to grass and used as safe waterways. Gullying is prevented and the grass may be cut for hay

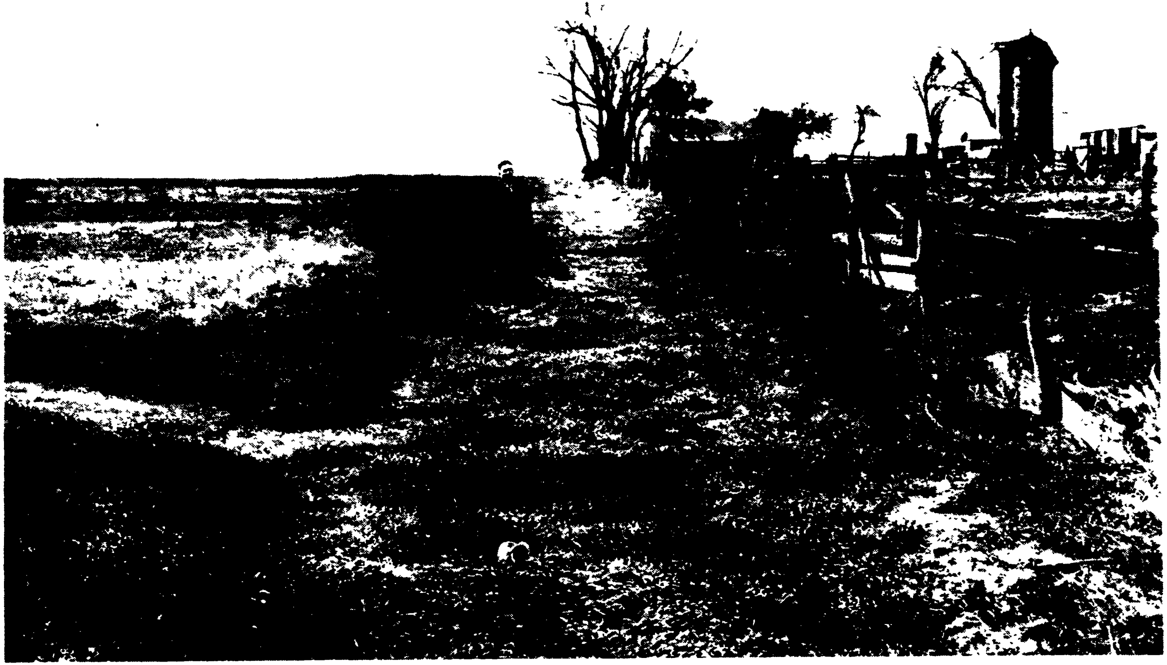


Fig. No. 7.—Broad shallow grassed drains ensure safe disposal of water which must be taken down a boundary.

With regard to (*g*), this involves attention being paid to the outlets of contour ridges to storm drains or natural drainage channels to ensure that the strip between the end of the ridge and the drains, if on a steep grade, is adequately protected by grass or some other form of cover.

If the water is discharged from the ridges on to the natural veld steps must be taken to ensure that the water is spread at intervals over as wide an area as possible to prevent concentration in a defined channel, and also the area must be maintained under a good grass cover.

GRASSED OUTLET DRAINS AND GRASSED WATERWAYS.

As previously stated, erosion only occurs when the speed of the water exceeds a certain critical velocity which varies with the type of soil and the nature of its cover.

Any form of plant cover tends to reduce the velocity and in addition affords a degree of protection to the soil. Short thick grass which completely covers the surface gives the highest possible amount of protection. Details of suitable grasses are given in Bulletin No. 1016 by S. D. Timson.

A velocity of two feet per second will erode bare soil, but water flowing with a speed of 6 feet per second may be safely passed over thick turf.

It is at times impossible to construct drains of the ordinary type, as described in Part II. of the Soil Water Conservation Bulletin, on such flat gradients that the speed of the water will not exceed the scouring velocity.

In these cases, however, if the drain is made sufficiently wide in order to reduce the depth of water flowing in it the velocity of the water may be kept below 6 feet per second even on slopes as steep as 1 in 20, and as mentioned above this velocity will not cause erosion if the drain is well grassed. See Figs. Nos. 7 and 8.

It is obvious that this is the cheapest form of protection that can be adopted and is preferable to the use of structures such as bolsters or masonry drops, which are more costly and should only be resorted to where gully erosion has already occurred.

The only objection that can be raised to this type of drain is that it takes up too much land. This objection, however, is over-ruled by the facts that the area taken up by the drains need never exceed 1% of the total area of the land and that gullies would eventually ruin a bigger area.

Further, these drains can be utilised as headlands, are capable of being crossed by animals and most implements, and provide areas from which hay may be reaped.

When new lands are being brought under cultivation much work and future trouble will be saved by selecting suitable hollows and leaving them under grass so that they may be used to receive the water from drains and ridges. The natural grass cover will be improved by mowing, but bare or poorly covered patches should be planted to grass, otherwise a gully will commence at these weak spots.

If there are no definite hollows a strip of ample width should be left running down the slope; later, when it is desired to use this strip as a drain, low banks 12 to 18 inches in height are constructed along each edge to confine the water to the strip. The soil to form these banks should be obtained from outside the strips in order that the grass cover will not be disturbed.

Any minor gullies in the strip should be obliterated and the bed of the drain made level at right angles to the direction of flow of the water. This can often be most conveniently effected by constructing low banks of sods about 4 inches in height across the drain at intervals of about 50 feet—the sods being held in position by wire netting staked down.

In all cases tall or tufty grass should be cut down in order to permit of the water being spread and to encourage the growth of a short grass cover.

The outlets of contour ridges discharging into shallow drains must be curved downwards as shown in Fig. 29, Soil and Water Conservation Bulletin, Part II., but if a broad natural hollow is used the outlet may be constructed as shown in Fig. 28 of the same Bulletin.

In the following table are shown the maximum acreages that can be safely allowed to discharge into grassed drains 25 to 50 feet in width on steep slopes varying from 1/30 to 1/20.

TABLE A. CAPACITIES OF GRASSED DRAINS.

Width of drain:	Safe Drainage: Area Contour Ridged Lands.		
Feet.	1/30 slope. Acres.	1/25 slope. Acres.	1/20 slope. Acres.
25	50	40	35
50	100	80	75

If wire and stone bolsters with aprons are placed at intervals of 150 feet, a 25 foot width of drain can be utilised for dealing with the discharge from the acreages given above for a 50 foot width of drain.

The side slopes of these drains should be gentle and not steeper than 1 in 3, and the minimum height of the bank should not be less than 12 inches.

THE PLACE OF STRUCTURES IN GULLY CONTROL.

Erosion in gullies could be entirely controlled by structures alone, but the cost would be excessive. For greatest economy vegetation must be utilised to the maximum but a sufficient number of structures must be put in to reduce the velocity of the water to such a speed that it is possible to establish vegetation. There are cases where the protection of a gully from stock and fires would, with a minimum of planting, ensure its complete revegetation.

Usually, however, the volume of water is too great, the banks are steep and crumbling and the bed of the gully has very often cut down to sterile subsoil. Even in such cases it is possible that structures may not be necessary if the water can be temporarily diverted for a time, and the banks of the gully sloped off and the banks and bed seeded or planted to grass.

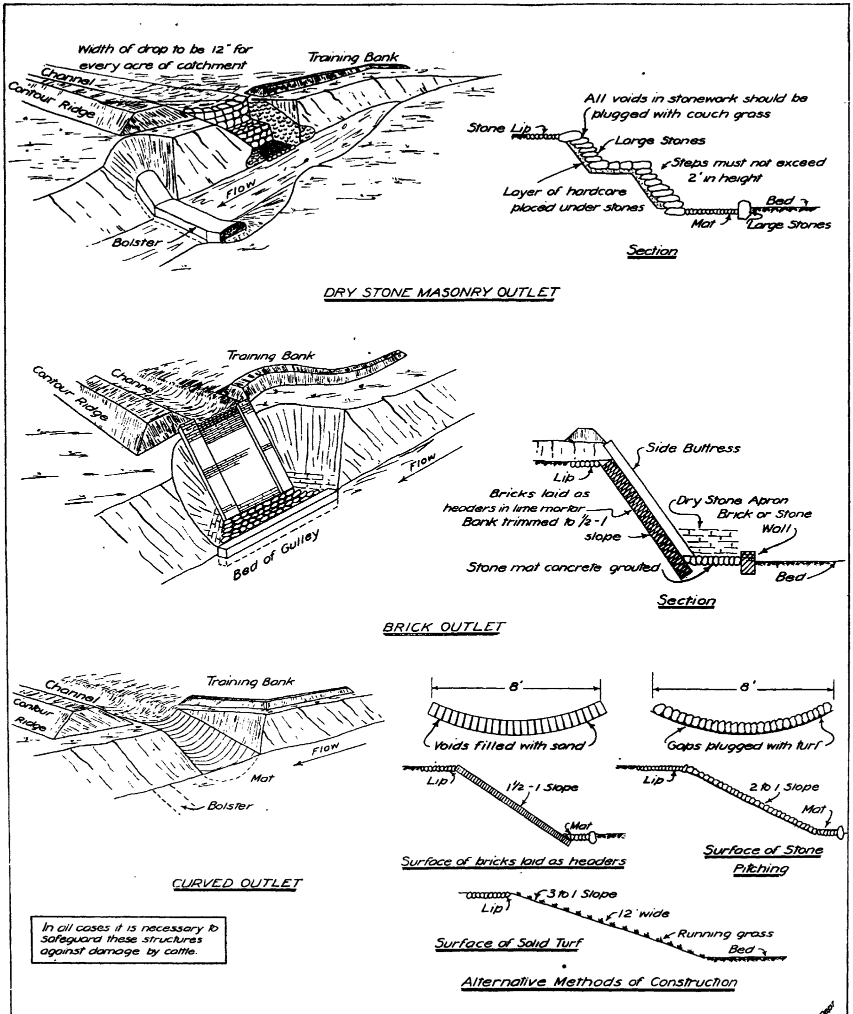
To temporarily divert the water very broad channels can be made alongside the gully, seeded to Rhodes grass or even an annual grass like teff, or a mixture, and used for one or two years whilst the gully is being treated.

Vegetation will not grow on side slopes that are crumbling. The side slopes of the gully must be made at least as easy as the stable slope for that type of soil when loose. In order to keep the velocity as low as possible the bed of the gully should be made wide so that the depth of the water is shallow. Small gullies can be treated at a surprisingly rapid rate by a gang of natives. Until such time as big tractors with suitable equipment are available the control of big gullies is most economically effected by doing the work in easy stages.

In the majority of cases it may be found impossible to reduce or temporarily divert the flow of water and structures must then be used to a greater extent. It will seldom be possible or economical for a farmer to complete all the structures in one season. It is most satisfactory to plan the work by stages in advance and after observation of each stage so plan that the most beneficial or urgent work will be tackled next. By forethought and utilisation of vegetation much money and labour can be saved. It is worse than useless to do the work in a haphazard fashion. Banks should not be sloped off and loose soil exposed if there is not time to establish cover before water can be expected to run in the gully. High structures at great intervals are likely to fail as the rush of water will not have been sufficiently reduced. First bends and obstructions which cause under-cutting of the opposite bank must be smoothed out or removed. Now structures should be built and the general work of sloping off and planting commenced just below each place where erosion is worst. As these works begin to give some relief advantage can be taken of natural facilities to choose places where more grass can be successfully planted.

Very often a portion of the gully has sufficient cover to protect one side of the bed; if this cover is improved and the other side raised and planted a short section of the gully will rise due to silting, thus forming a natural restriction to the flow, making it possible to spread treatment upwards for a short distance.

Further treatment should not be delayed when this occurs, as the silting of a small area will result in a steeper grade below which may be sufficient to cause head erosion



DRY STONE MASONRY OUTLET

BRICK OUTLET

CURVED OUTLET

Alternative Methods of Construction

In all cases it is necessary to safeguard these structures against damage by cattle.

CONTOUR RIDGE OUTLETS INTO GULLIES

Irrigation Dept
Salisbury
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in the raised section of the bed and thus undo the good work. If the gap between grassed sections is of any length low bolsters a few inches in height with narrow aprons below should be constructed immediately below each section, and at intervals between these to be used as starting-off points for new sections of grass when silting occurs. In this way the entire length of gully can be eventually grassed.

Where sub-soil is exposed on the sides it may be necessary to spread a layer of topsoil or apply fertiliser. In these cases the surface should be lightly mulched with straw and this may make all the difference between absolute failure and success.

Very large gullies or narrow vertical sided deep gullies may require the use of structures, but in the case of the latter if temporary diversion of water is possible, it is obvious that the sloping off of the banks and planting to grass is the most economical method. As soon as the bed has become grassed and the under-cutting of banks prevented by the construction of bolsters at intervals, the entire length of bank should be gradually sloped off.

If done a little at a time and the soil is spread on the bed the grasses recommended for gully control will rapidly come through and hold this soil. As the bed rises the bolsters may be heightened by placing additional bolsters just above and against existing bolsters.

The aim should be eventually to attain a broad waterway with gently sloping banks all well covered with grass and capable of taking the worst floods without danger of over-topping.

PREVENTION OF EROSION AT OUTLETS INTO GULLIES OR DRAINS.

Unless control measures are undertaken head erosion soon commences in the channels of ridges or drains where they discharge into existing gullies or deep storm drains.

The following are the preventative measures recommended, and are illustrated in Fig. No. 9:—

(1) *Grassed Outlets.*—A strip 15 feet in width with a bed slope of not more than 1 in 3 and side slopes not steeper than 1 in 2 is excavated at the outlet into the gully and the whole area established under a cover of thick short grass before being put into use.

(2) *Stone and Grass Outlet.*—The strip in this case need only be half the width given above and its bed slope may be as steep as 1 in 2. The whole area is pitched with stone and live sods and roots of couch grass packed between and under the stones.

The stones should be laid as "headers," as slabs of stone laid flat are bound to dislodge. The grass should normally grow sufficiently in about a month to enable the outlet to be put into use.

(3) *Dry Brick Outlet.*—A sloping concave arch of dry bricks is made as follows:—The bank of the gully at the outlet is cut back at a slope of 1½ to 1 so that the toe of the slope is at least one foot inside the side of the gully. This slope is then hollowed out to form a semi-circular channel with a bed width of 8 feet. The excavation should be carried down below the level of the bed of the gully and squared off to form a semi-circular face at right angles to the slope of the outlet. Courses of bricks are now laid as "headers on edge" across the bed of the channel, commencing at the foot of the slope, and continued until the level of the contour ridge channel is reached. As each course is completed dry sand is packed in the triangular voids between the bricks.

(4) *Inclined Masonry or Brick Drops.*—In the case of outlets to deep gullies it is necessary to construct a drop-wall of 9 inch brick work laid in cement mortar or of grouted stone pitching or of bolsters in steps. Fig. No. 9 shows an inclined brick drop wall, whilst included in Fig. No. 10 is a drawing of a design for a bolster or stone pitching drop-wall which may, after slight modification, be used as an outlet.

(5) *Dry Stone Masonry Steps.*—This design of outlet can be constructed where there is readily available a

sufficient supply of slab-shaped stone. The steps are cut out and stones chosen that fit well. As they are laid a filling of "hard core" is well rammed behind so that they lie and fit snugly.

Important.—All these outlets need some form of apron from the foot of the outlet across the bed of the gully, and if the gully has appreciable slope or is eroding a bolster with an apron below it should be placed across the gully below the outlet and as close as possible after allowance has been made for the additional bolsters which are to be placed there later as the gully bed is raised.

STRUCTURES FOR GULLY CONTROL.

When structures are erected in gullies to control them it is sound practice to make haste slowly and not to attempt to erect too high a structure which would have the effect of so blocking the channel that high floods would be diverted round the sides of the structure and cause them to be outflanked by further erosion.

It is essential, therefore, that these structures should be low, a safe height being dependent on the depth of the gully and the area drained by it, be dipped towards the centre and carried well into both banks which have also to be protected from scour by stone pitching or other means.

In addition it is necessary to have some form of protective mat or apron across the bed of the gully below the structure in order to prevent scour there by the falling water which would result in the undermining and ultimate failure of the whole work.

The higher the structure the greater the pressure of water endeavouring to force a passage round or underneath it, and therefore the more there is need to ensure that the structure is carried far enough into the sides and down into the bed. Any seepage will eventually undermine and cause the failure of the structure.

The following table indicates the length of spillways which are required to deal with the maximum flood discharge from catchments of varying size if the depth of flow over the crest is not to exceed a specified amount and will therefore be useful for determining the height above the crest of the structure to which the protective covering on either flank must be carried.

TABLE B. CAPACITIES OF SPILLWAYS.

Maximum depth of flow over crest	Drainage area in acres: 5	10	15	20	25	50	100	150	200	300
Feet	Length of spillway crest in feet.									
0.5	15	27	38	47	54	94	155	210	260	335
1.0	4.7	8.4	12	15	17	30	48	64	80	101
1.5	2.6	4.6	6.4	8	9.2	16	26	36	44	56
2.0				5.2	6	10.5	17	23	29	37
2.5						7.5	12.2	16.6	20.6	26.6
3.0						5.6	9.3	12.6	15.6	20
3.5							7.4	10	12.4	16
4.0								8.2	10.2	13.1

It is safe practice to allow an additional 6 inches over that given in the table, *i.e.*, if the maximum depth of flow over the structure is not anticipated to be more than 18 inches carry the side wall on either flank to a height of 2 feet above the crest.

The width of the apron should be at least twice the height of the structure. If these principles are adopted these structures will not fail.

As previously stated the object of these structures is to flatten the gradient of water flowing in the gully and thereby reduce its velocity to such a speed that erosion will not occur and vegetation can be established in the intermediate sections.

The number of these structures will be dependent on the bed slope of the gully and the height of the structure as in general they should be so spaced that the crest of one structure is level with the toe of the apron of the structure above it.

Their number would therefore be reduced if the height of each structure was increased, but as previously stated this is often dangerous and it is preferable to have numerous low structures which are relatively less costly.

Assuming that the structures are only 2 feet in height and allowing for a 4 foot width of apron, this would result

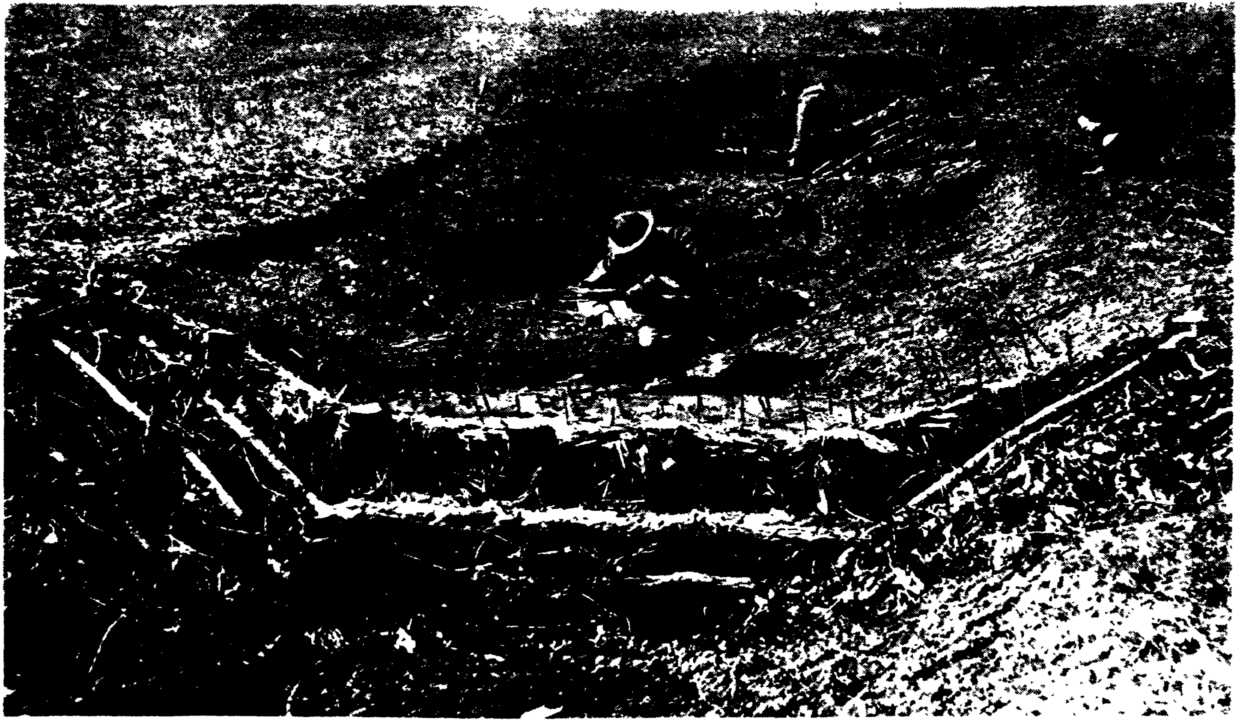

Fig No. 11.—Temporary check-dams of poles, wire and trash. Slips of trees are being planted in the silt to form a permanent living barrier.

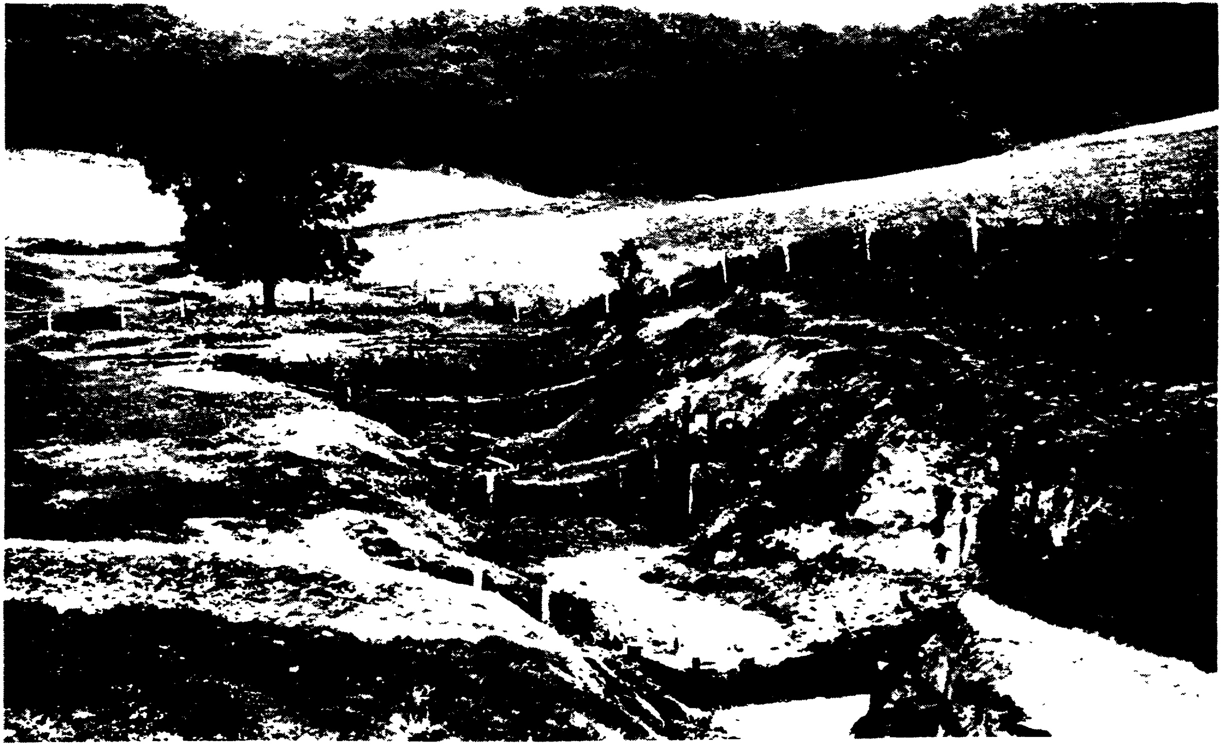

Fig. No. 12.—Check-dams of poles, wire, brush and stone at the head of a gully. The sides and head of the gully will now be sloped off and planted to grass, and the bed planted as soon as silt has collected above the check-dams

in them being spaced at intervals of 44 feet for a slope of 1 in 20 and at intervals of 104 feet for a slope of 1 in 50 and so on.

When reclamation work in gullies is undertaken it is sound practice to extend the operations from the head of the gully downwards, and even if the head of the gully only is protected it will at least be prevented from cutting back and extending further upstream.

In the case of small gullies head erosion can be prevented by merely cutting back the head and sides of the gully on a slope of 3 to 1 and planting sods of couch or paspalum which is held in position by wire netting fixed to stakes.

In the case of larger gullies it is necessary to protect the head by means of a brick or masonry drop wall as shown in Fig. 10, or alternatively by wire and stone bolsters or stone pitching also shown on the same sheet.

In the latter case the head of the gully should be cut back on a slope of 1½ to 1 and the stone pitching carried up the sides to a height of at least 3 feet.

Earth training banks are also usually required at the head of the gully to ensure that maximum floods are delivered over the protected crest of the gully and not over the sides of the channel along the pitched slope.

The following are the structures recommended. The principle.ones are illustrated.

Note.—In cases of uncertainty or where the depth of the gully exceeds 8 feet expert technical advice should be sought, as large gullies and unusual problems require specially designed structures.

1. *Sod Bolsters.*—These are really only suitable for use in checking minor gullies in their early stages or for spreading the water at intervals in grassed drains as previously stated.

The bed of the gully or drain should be levelled off and a solid bank of sods of common couch, not more than 6 inches high and 2 feet wide, is placed and firmly fixed by a row of stakes on the lower side and covered with wire netting, securely pegged, which can be removed as soon as the grass roots have become established.

The bolster should be extended up both banks of the gully, which should be cut back to a slope of 3 to 1 or even 4 to 1 if composed of black vlei soil and the sods laid in a trench 6 inches deep cut on the sides.

2. *Low Earth Banks.*—These are suitable for use if limited to a maximum height of 2 feet, under similar conditions as apply in (1), or in cases where a wide vlei has to be protected against gullying and where the maximum depth of water flowing over the bank is never likely to exceed 6 inches.

The crest width of such a bank should be 3 feet with a downstream slope of 4 to 1 and an upstream slope of 2 to 1, *i.e.*, the width of the base for a 2 foot height of bank must be 15 feet. The crest and downstream slope should be covered with sods of paspalum or couch tied down with wire netting and also extended along the toe of the bank for a distance of 4 feet and both banks of the gully for a distance of 20 feet measured from the upstream face of the bank should be similarly protected. The sides of the gully should be sloped back as in (1) prior to the placing of the sods.

If the depth of water flowing over the bank is likely to exceed 6 inches, the downstream face should be protected with stone pitching and roughly grouted with cement mortar or the intertices plugged and well rammed with sods of couch or paspalum.

3. *Bag Check Dams.*—Temporary check dams may be constructed of bags filled with sand, soil or rubble provided their height is limited to a maximum of 12 inches.

A double row of bags is necessary if the height of the structure exceeds 6 inches, and in these cases the bags should be placed so that the joints are staggered.

A row of stakes with a wire netting fence as high as the structure should be constructed on the downstream side to hold the bags in position.

The bag bolster should be carried up both banks of the gully as detailed in (1), the trench being excavated to take a single row of bags placed endwise on with the tops of the bags flush with the surface.

4. *Wire Fence Dams.*—These, if limited to a maximum height of 18 inches, are suitable for use in wide shallow gullies of moderate slope with relatively small drainage areas. The fence should be constructed in the form of an arc with the open end upstream as shown in Fig. No. 10.

A row of posts should be set at intervals of 4 feet along the arc and driven into a depth of 2 to 3 feet. Stout wires (or a cable) are run along the post and carried by trenches in the sides of the gully and fastened to substantial anchors buried well in from the sides.

Heavy gauge wire mesh is attached to the posts and carried down in a trench to a depth of 6 inches below the ground surface. The top of the fence should be approximately level across the bed of the gully and carried up to the top of each bank which is cut back to a slope of at least 1½ to 1.

Fine brushwood or grass should be packed across the upstream side of the fence and banked with earth fill on a slope of 2 to 1.

An apron 4 feet wide should be constructed either of stone or of brushwood with the butt ends passed through the meshes of the fence.

5. *Brushwood Dam.*—These in effect consist of a mat of brushwood about 9 inches in depth spread for a length of 10 feet across the bed and up the sides of the gully which have been cut back to a 1½ to 1 slope. Rows of stakes at intervals of 3 feet are driven in over the whole area and the brushwood is kept in position by fencing wire fastened to these stakes which are then driven in further and the brushwood compressed.

6. *Loose Rock Fill Dams.*—These are suitable for use in gullies with medium sized catchment areas in localities where large flat stones are available.

The stones should be laid as "headers" to form a paved drift with a crest width of 2 feet, the upstream side vertical and the downstream side on a slope of 1 to 1 with a 4 foot wide apron of stone. If more convenient the downstream slope may be left vertical if stout posts are driven in at 4 feet intervals on either side of the structure, and stout wire mesh netting fixed to these posts to cover the crest to prevent the stones being dislodged during high floods.

The maximum height of structure recommended is 2 feet, and the crest should be dished to form a flat arc with the lowest portion at the centre of the gully.

The structure should be extended to the top of the banks of the gully, cut back to a slope of 1½ to 1, or carried far enough up the sides to be at least 6 inches above the anticipated maximum flood level as given in Table B.

A shallow trench is made along the whole width of the structure against it on the higher side, and filled with well rammed soil. On top of this a sloping bank of well rammed soil is made, reaching to the crest of the spillway, and carried right up the sides.

7. *Stone and Wire Mesh Bolster Dams.*—These are the most suitable and economical for use under a variety of conditions as they permit of the structure being raised from time to time, as silting occurs, by the placing of another bolster immediately upstream of the former one.

In addition any shape of boulder or stone can be utilised, the only condition being that the majority should be larger than the size of the wire mesh which encloses them.

The bolsters are approximately square in section and may be of any size up to a maximum of 3 feet. A trench 9 inches deep and with a width equal to the width of the bolster proposed is excavated across the bed of the gully and carried in on the level for a distance of 3 feet into either bank and thence upwards on a slope of 1 to 1 to the top of the bank or at least sufficiently high to end off above the anticipated highest flood level. A 3 inch layer of gravel is then spread in the trench.

Stout wire mesh which is four times as wide as the bolster proposed plus 6 inches for overlap is laid across the trench in the bed and on the sides.

Boulders and stones are packed in this netting until the required width and height of the structure is obtained, when

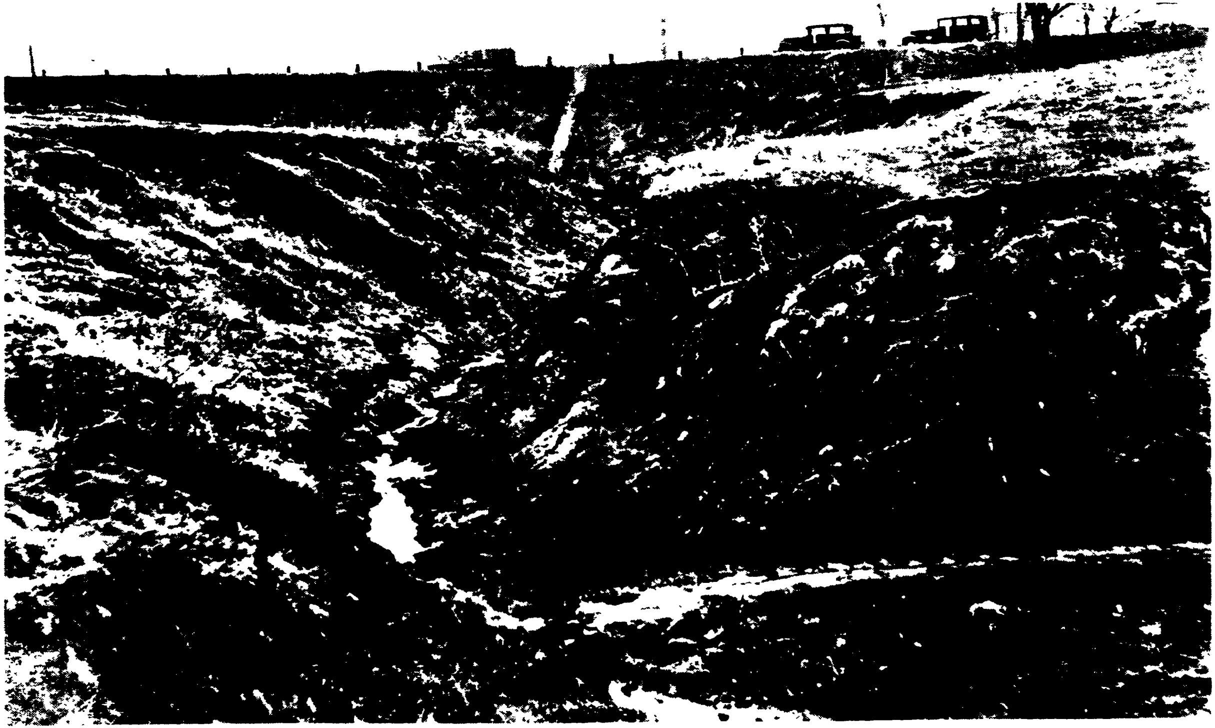

Fig. No. 13.—An actively eroding gully Compare this picture with Fig. No. 14.

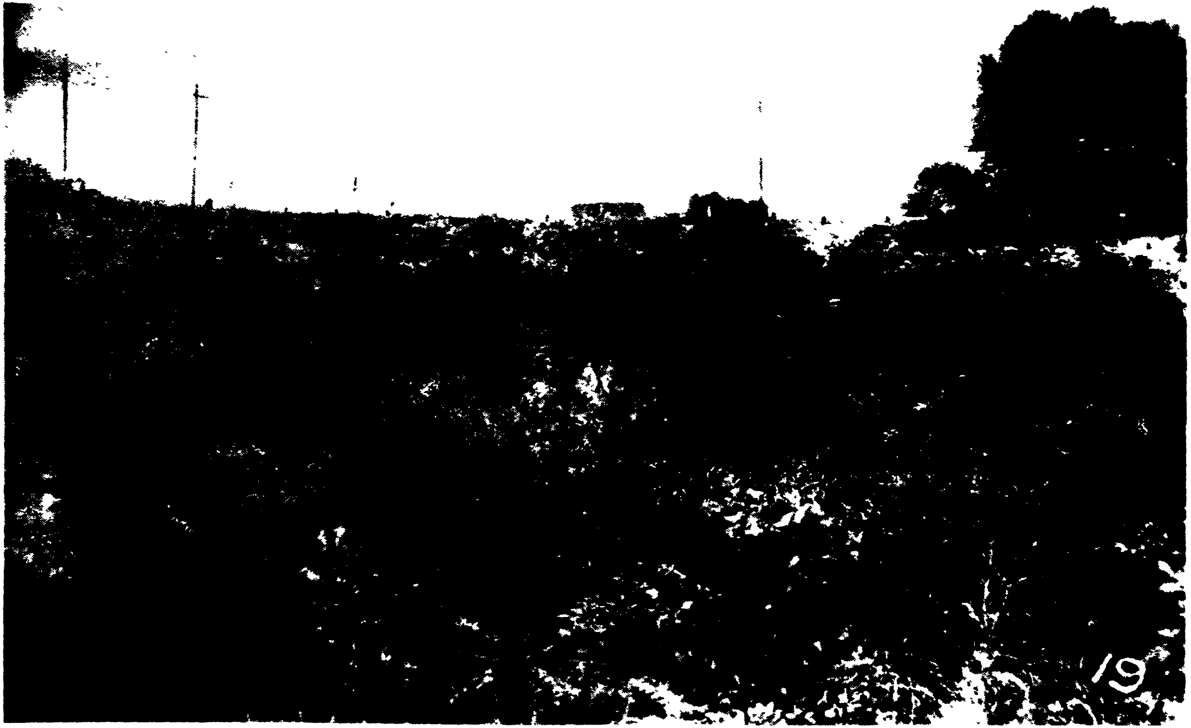

Fig. No. 14.—The same gully as Fig. No. 13. some years after planting to a mixed stand of shrubs and trees.

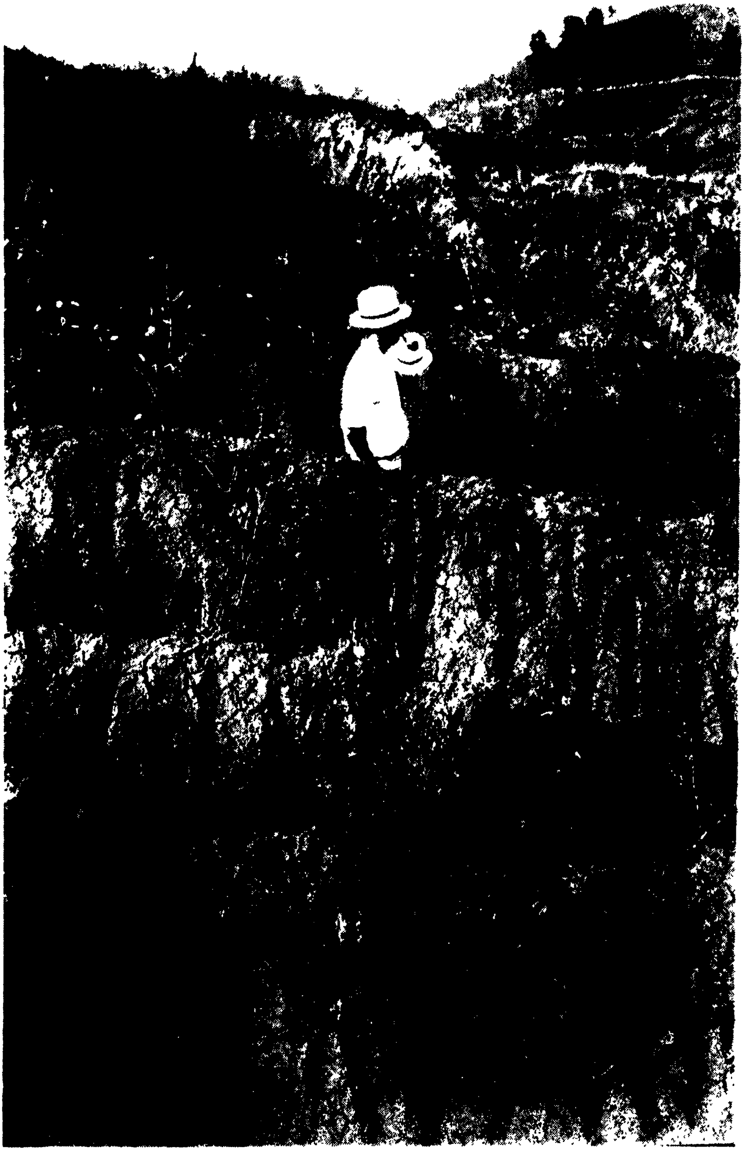

Fig. No. 15—A severely gullied area. Compare this picture with Fig. No. 16

Fig. No. 16.—The same area as Fig. No. 15 a year after the banks had been raked down, mulched with straw and seeded to vigorous legumes and grasses.

the sides of the netting are drawn together and the overlapping portions tightly laced together.

If the bed of the gully is more than 5 feet wide fencing standards or hard wooden posts must be driven in to a depth of at least 3 feet at 5 feet intervals along the downstream side of the bolster to hold it in position.

An apron of stone 4 feet in width either roughly grouted with cement or covered with wire mesh must be constructed on the downstream side of the bolster across both the bed and the side of the gully. If the stones are plugged with live grass roots the wire may be removed as soon as the grass has a hold.

If a structure higher than 2 feet is required in the first instance, then two separate bolsters must be laid side by side across the bed of the gully and a third bolster constructed on top of the upstream one.

Only the downstream bolster, however, need be carried up to the top of the bank, but each bolster must be anchored by being continued 3 feet into either bank.

8. *Masonry or Concrete Dams.*—This is an expensive form of construction and should only be adopted in cases where a permanent structure is required across a gully which it is intended to maintain as a waterway and not to be silted up by the construction in future of semi-permanent works downstream of the structure proposed.

It is essential that rock foundations should be available for this type of structure and that wing walls of adequate height should be constructed to prevent the danger of the work being out-flanked in high floods.

It is desirable, therefore, to have the advice of officers of the Department as to the suitable design and location of these works before their construction is undertaken.

Straw and Brushwood Mulches and Mats.—As an alternative to brushwood check-dams brushwood may be utilised to cause deposition of a small amount of silt, to protect the surface from further erosion and as a shelter for establishing vegetation. This method is particularly applicable to sloping gully banks and the beds of gullies in which the flow of water is shallow.

After the slopes have been raked down seeds or grass roots are planted. A layer of straw of sufficient thickness to almost cover the surface is then spread and on this is placed just enough brushwood to hold the straw in position. The brushwood is then pegged down with stakes.

Though it is essential that the mulch be sufficient to prevent erosion it must not be thick enough to smother the young plants. If the soil is sterile it should be treated previously to planting with a light dressing of fertiliser or half rotted compost.

If the stakes are made from live cuttings of willow, poplar or mulberry many will take root and eventually form a living barrier. As regards grasses, the giant strain of common couch grass is the most suitable, as this grass will readily run through the thin layer of brushwood. In many cases amber cane and sunnhemp may be seeded with advantage, and though they naturally will make a poor growth, they will hold the soil and prepare the way, and later act as a protective straw mulch for more permanent forms of vegetation which are either planted at the same time or early the following season.

Where banks are being undercut the bank, after being sloped off, should be protected by roughly woven mats of canes, reeds or willows from the lower edge to well above the highest flood level. Additional protection along the lower edge will be required if the flow of water is strong. This should consist of stone pitching or bolsters. The mats should be staked with live willow cuttings, or if these are not available, the bank should previously be planted with reeds or canes.

Figs. Nos. 11 to 16 illustrate methods of establishing vegetation in gullies and the results attained.

Choice of Structure or Outlet.—It will have become obvious after reading this section of the Bulletin that the structures recommended utilise a wide range of materials. A choice can therefore be made according to the type of material which is cheapest or most readily available.

MAINTENANCE OF STRUCTURES.

Cattle not only destroy plant cover which might otherwise assist in controlling a gully but can also do considerable damage to gully control structures. Cattle must be kept out of gullies and particularly sloped off banks. Some form of fencing is essential, and if wire cannot be afforded thorn branches should be pegged down around all sloped off banks and structures. A log laid along the top of the bank will act as an additional deterrent.

Acknowledgments.—Figs. Nos. 7 and 8 and 11 to 16 were prepared from photographs supplied by the Soil Conservation Service of America. Other material and information supplied by the same service have greatly assisted in the preparation of this and other sections of the Soil and Water Conservation Bulletin and Bulletins on related subjects.

Report of The Chief Animal Husbandry Officer

FOR THE YEAR ENDED 31st DECEMBER, 1939.

By A. E. Romyn, Chief Animal Husbandry Officer.

Cattle Industry.—Cattle farmers have had a good year. Prices for all classes of stock have been satisfactory with an upward tendency in value throughout the year. As a result of these prices there has been a return of confidence in the industry, which has been reflected in the greater interest that is being shown in improved stock management.

Cattle did not do particularly well during the early part of the year when conditions in many parts of the Colony were over wet for stock. For a period also many dairymen reported difficulty in getting cows in calf. Cattle, however, wintered extremely well and were generally in exceptional condition by the end of the year, and the condition of slaughter cattle, either for export or the local market, should be well above normal by January, 1940.

Two features of cattle management which deserve comment are an increase in the practice of dosing young stock for internal parasites and the noticeable spread in the practice of dehorning beef cattle. In the former connection an experiment in progress in co-operation with the Director of Veterinary Research at the Grassland Station, Marandellas, has caused much interest. The cattle bale which has been erected for the convenient handling of stock when dosed has been widely copied. To the knowledge of this Division over fifty bales have been erected in Mashonaland during the latter part of the year, which indicates the more active interest cattlemen are taking in the handling of their cattle. Further information is required before it can be stated to what extent the practice of dosing cattle for worms is necessary, but many owners are of the opinion that it has been extremely beneficial under their conditions this year.

Export of Beef.—Since September, 1939, this Division has not had any direct communication with the export of beef overseas. The Government grading service, which was formerly the chief point of contact, was discontinued at the commencement of the war, and since that time the export of beef, and such grading as is necessary under present conditions, have been carried out by the Cold Storage Commission. It is consequently not possible to present a report on the export of beef as has been customary in previous years.

One result noticeable as a result of the shortage of cattle for export is that the prices realised for some of the lower grades of cattle for export have become more profitable than those paid for the better grades. There has been a tendency in consequence for producers to drift away from the production of the more exacting young bullock (three and four years old) to the production of heavier, older cattle, which are easier and cheaper to feed and can also be marketed direct off the grass at certain times of the year.

This development may be expected to continue during the war, when a premium on extra quality tends to disappear. The future of the chilled beef trade still depends on an improvement in the average quality of the beef exported. This improvement requires, in most cases, the proper culling of the breeding herd, the use of better bulls and the feeding of young stock over the winter. These changes in stock management are, from the human standpoint, easier to effect in a period of good prices, such as at present, than in a period of low prices and surplus which normally follow the unheaval of war. The present tendency is therefore not in the long time interests of the chilled beef industry.

Local Market.—The local market has been maintained at what is generally considered a very satisfactory level throughout the year. The scale of prices fixed by the Cold Storage Commission has in the main set the standard of value on the local auction markets, but prices have not infrequently been above these values and compound cattle have sold at 25s. per 100 lbs. dressed weight and good primes at 40s.

The export of cattle to the Johannesburg market has been prohibited since October last. Cattle previously exported to

Johannesburg have, however, been absorbed by the Cold Storage Commission at approximately the local parity of Johannesburg prices and the regulation has therefore had no marked effect on local prices. As a further move for the conservation of supplies the slaughter of good breeding stock has been prohibited since December. It is too early to forecast the effect of this regulation, but no marked effect is yet apparent.

Purebred Cattle.—The improvement in the price of cattle has caused a keener demand for bulls than at any time during the last ten years. Breeders of pedigree stock have had a good year and there has been some enquiry for pedigree female stock, which is a welcome improvement on recent years. The pedigree herds in the Colony are still far too small in numbers to meet the needs of the Colony for improved bulls and a number of young bulls have been put into heavy service at too early an age, and underfed. For the time being it will be necessary to continue to organise the bulk importation of bulls from outside the territory on the lines now followed by the Livestock Improvement Committee, in order to maintain the present rate of progress.

Livestock Improvement Scheme.—During the year 1939 the direction of the Livestock Improvement Scheme was broadened and placed under the control of a committee consisting of the Chief Animal Husbandry Officer and Mr. G. N. Fleming and Mr. A L. Millar, representing the Mashonaland and Matabeleland stock farmers respectively. The scope of the Scheme was further widened by the provision of special funds for the making of loans to farmers towards the purchase of purebred bulls and, in certain circumstances, of pedigree female stock as well.

A further important development has been the bulk purchase of bulls in the Union of South Africa and South West Africa by the committee, in order to supplement Rhodesian supplies. Up to December 31st, 142 bulls were imported in this way for distribution to farmers and ranchers. At the time of writing the committee has on hand orders for a further 85 bulls, the majority of which it is hoped to purchase before the end of the present financial year. These bulls will be widely distributed and should have an appreciable effect on the improvement of the herds to which they are sent.

The effect of these changes in administration has been to popularise the Scheme and increase its appeal, and the original provision of £5,000 under Vote 36 III.C was increased during the year by a further £3,000 to meet the demand. At the time of writing the whole of this £8,000 has been provisionally allocated. In the near future the further expansion of the Scheme on its present basis is more likely to be limited by a shortage of suitable bulls than by lack of funds.

The expansion of the Scheme has entailed a very great deal of work on the part of the persons responsible for its administration. Owing to the shortage of staff there have been delays in making grants in individual cases and some earlier decisions have had to be reversed, but on the whole the Scheme has operated efficiently. The thanks of this Department are due to the farmer members of the Committee for thir help and initiative. Record should also be made of the good work of Mr. P. Hinde, as Secretary of the Committee.

The number of applications received up to the 31st December, 1939, is shown in the table below.

	Received.	Approved.	Withdrawn.	Refused.	Under consideration.
Grants	363	276	9	30	48
Loans	137	89	4	14	30

Of the 276 applications for grants which have been approved to date, 155 have been paid the grants due, whilst 34 of the approved loans have actually been paid.

The grants paid to the 155 applicants were in respect of 239 bulls and 9 cows or heifers of the following breeds and origin:—

BREED.	ORIGIN.								TOTAL.	
	Southern Rhodesia.		Union of S.A.		S.W. Africa.		United Kingdom.			
	Bulls.	Cows or heifers.	Bulls.	Cows or heifers.	Bulls.	Cows or heifers.	Bulls.	Cows or heifers.	Bulls.	Cows or heifers.
A. Angus ...	49	—	1	—	—	—	2	—	52	—
Africander .	44	—	2	—	—	—	—	—	46	—
Sussex	16	—	7	—	9	—	—	—	32	—
Red Poll . .	28	—	2	—	—	—	—	—	30	—
Hereford ...	20	—	6	—	—	—	—	—	26	—
Friesland . .	9	—	16	5	—	—	—	—	25	5
Shorthorn . .	11	—	2	—	—	—	3	—	16	—
Guernsey . .	—	—	1	4	—	—	—	—	1	4
N. Devon . .	3	—	2	—	—	—	—	—	5	—
Ayrshire ...	2	—	2	—	—	—	—	—	4	—
S. Devon . .	1	—	—	—	—	—	—	—	1	—
Brown Swiss	—	—	1	—	—	—	—	—	1	—
Totals ...	183	—	42	9	9	—	5	—	239	9

For the same period in 1938, 247 applications were received, of which 175 were approved.

On December 31st the Committee had on hand a total of 95 bulls undergoing inoculation which do not appear in the table of bulls distributed. It has also, as previously stated, a further 85 bulls under order.

The Livestock Improvement Scheme has been in operation for five years and has become a potent, if limited, influence for better stock management. As an example of one of its effects, an extract from the Annual Report of Mr. R. H. Fitt for 1939 may be quoted here. Mr. Fitt, who has carried out a greater number of inspections under this Scheme than any other officer of this Department, states:—

"For five years I have been carrying out inspections. I can remember that during the first year half of my reports were adverse. In ninety per cent. of these adverse reports I had to state that breeding was uncontrolled, *i.e.*, no effort was made to keep heifers from the bulls until they reached breeding age. This year, in well over double the number of reports, this remark was only necessary in twelve cases."

Grading of Beef for Local Consumption.—The grading of beef for local consumption in Bulawayo was discontinued in May, 1939. In the circumstances the apathy of the public and the lack of support from the trade proved too great an obstacle for the optional grading system in force. The failure of this system of grading is a reflection on the depth of the public clamour for better beef in this Colony. It is hoped that grading will be reintroduced at a later date when conditions are more favourable as, until an effective local demand for good beef has been created and is catered for, the producer of improved cattle will continue to be dependent almost entirely on the overseas market, over which we have no control, for his living.

Pig Industry.—The bacon factories in the Colony are understood to have maintained the following prices for bacon pigs during 1939:—

Grade A—5½d. per lb. live weight.
Grade B—5d. per lb. live weight.
Grade C—4½d. per lb. live weight.

These prices are ½d. per lb. in advance of the minimum prices fixed by the Pig Industry Control Board. First quality porkers have sold at up to 7d. per lb. dressed weight in Salisbury.

Despite these prices production has not shown the general increase anticipated for 1939 and supplies have been insufficient for local requirements. While there has been considerable expansion in Matabeleland and the Eastern Districts, in the maize districts of Mashonaland, with their greater possibilities for pig production, there has been little progress. The lack of increase in Mashonaland can be attributed to:—

(*a*) The failure in many cases of pigs to thrive in the past. The producers concerned are chary of restarting or increasing their production.

(*b*) The 1938/39 maize crop has been short and many growers have considered it more profitable to sell their maize in the local pool rather than to feed it to pigs.

(*c*) The lack of confidence in one or other phase of the pig industry.

These causes operate less forcibly in Matabeleland and in the Eastern Districts, where producers generally have fewer alternative outlets for their energy and are seemingly satisfied with smaller returns.

Under present circumstances, however, it seems unlikely that local production will do much more than meet local requirements by the end of 1940, leaving only a small surplus for export out of the Colony.

Grading of Bacon Pigs.—Grading of bacon pigs, as laid down in the Pig Act, 1937, has been in operation throughout the year. The grading has been carried out by the Municipal Meat Inspectors in Salisbury, Umtali and Fort Victoria. In Bulawayo it was carried out in the earlier part of the year by the Government Meat Grader. When this post was closed down it was carried out for a short time by the Municipality, and since that time by the Veterinary Department. The grading service has, on the whole, operated satisfactorily and the appreciation of this Department for the assistance given by these various bodies must be recorded. Under the circumstances it has not been possible, however, to maintain the standard of uniformity desirable in grading from centre to centre, but variations do not appear to have been material.

The grading returns do not show any improvement in the quality of the baconers marketed in 1939 as compared with 1938. In fact, there may be some loss of ground, as some of the larger producers who were not satisfied with their grades have recently marketed all their pigs as porkers, which are not graded. A number of producers on the other hand have pressed for the tightening up of grading standards. These standards have not been altered in the last two years and some amendment in regard to weights and age are overdue. In view of the shortage of baconers and the likelihood of diverting further supplies to the pork market if the standard were raised, it was decided to make no alteration during the year just past.

The situation is not altogether satisfactory as, when a surplus arises, producers may be required during a period of lower prices to bring about the necessary improvement in the quality of their pigs in order to make them suitable for export. Degrading will then have a more serious effect financially than at present and cause more hardship.

Breeding Stock.—Shortage of breeding stock has limited expansion to only a minor extent, as the supply of Large White sows and Large White crossbreds for breeding purposes could have been materially increased if breeders had been more willing to keep back gilts from slaughter, or to overbid the bacon factories for gilts of bacon weights. There has, however, been a real shortage of Large Black sows and a good opening exists in the Colony for breeders of Large Black sows of good type. The Large Black sow has proved less exacting to maintain than the other types in use and has come back into favour during the last year.

Sheep Industry.—The summer of 1938/39 was excessively wet and unsuited to Persian sheep. Though the Merino sheep on the Eastern Border withstood the rainy season well, despite fairly severe losses from Blue-tongue, the rain was generally responsible for the reduced condition of sheep in the Colony during last summer. Sore feet were prevalent and there was an unusually severe and general infestation of Hookworm.

The majority of sheep farmers had, however, a very successful winter lambing season in 1939 and the lambs have grown out well. The improvement over last year is largely due to the prevalence of green grass in the winter months.

Flocks generally are improving in type, size and general health, and both Sheep Officers of this Division attribute this improvement to the more general practice of winter lambing and systematic dosing for internal parasites.

A good type of Persian ram is now being bred in the Colony. These rams are being purchased in preference to imported rams, as they are well developed, acclimatised and commence working well in the first season, which is not always the case with imported rams. There is still plenty of room for the breeding of more of these rams in the Colony.

This season's wool crop was better in quality than was expected. Despite the heavy rainy season, the general condition and weight of wool produced in the Eastern Districts was good, being well nourished, bright and clean.

There has been a steady market throughout the year for slaughter stock, and the past year has amply justified the view that sheep can be made a profitable sideline on most farms in the Colony.

Experimental Work.—The development of the Grassland Station, Marandellas, has been continued and preliminary results of some value have already been obtained.

Experiments are in progress on:—

(*a*) The productive capacity and utilisation of natural veld and improved pastures.

(*b*) The feeding of weaners.

(*c*) The control of internal parasites in cattle.

(*d*) Wintering of cattle.

A separate report on these experiments has been prepared.

This Division has co-operated in the experiments in progress and concluded this year at the Government Experimental Station at the Rhodes Matopo Estate, Bulawayo. These experiments also appear in separate reports.

Staff.—I wish to place on record my appreciation of the willing and efficient work of the staff of this Division during the past year.

Report of the Horticulturist

FOR THE YEAR ENDING 31ST DECEMBER, 1939.

By G. W. MARSHALL, Government Horticulturist.

Citrus Fruits.—Statistics of the 1939 exports of citrus fruits are not yet available, but an appreciable increase of over 50,000 cases above the previous year's exports was shipped. The final total of over 200,000 cases represents a record for the industry.

Export prices for citrus fruits were promising for the first half of the season, but the international situation in Europe unfortunately disorganised later shipments which sold at unremunerative prices. The average for the season is therefore likely to remain at a low level.

Deciduous Fruits.—This branch continues to make good progress. New plantings to the extent of several thousand trees were made during the year. These plantings were chiefly recommended apple varieties on seedling stocks.

The fruit crops were both larger and of better quality than usual, and this may be attributed to new trees coming into bearing, also to less hail and locust injury.

The small deciduous fruit orchard planted last year at the Umtali Experiment Station is making good progress and will be suitable for demonstration work forthwith.

Sub-Tropical Experiment Station.—The devolpment of this Station is now sufficiently advanced to justify a change over to the more serious work for which the Station was established. (Experiments to ascertain yields, values, etc., also raise and distribute selections considered to be of economic value for planting in this Colony.)

The fruit and other crops established at the Experiment Station to date are enumerated below, together with brief remarks regarding their behaviour.

Deciduous Fruits.—The small orchard of 200 trees was primarily established for demonstration work, but it will also be useful in demonstrating the effects of different stocks on growth and productivity of apple trees.

The second object is the testing of fruit varieties that may be of value for processing by the local fruit preserving company.

Locust injury last season affected the orchard rather badly, but most of this has now been rectified.

The trees established comprise:—3 varieties of figs, 7 varieties of quinces and 5 varieties of apricots for processing. Seven varieties of peaches, 6 varieties of plums, 21 varieties of apples for marketing. Japanese chestnut, seedless pomegranate and 12 varieties of grape vines are also growing.

The fruit trees and American vines are growing well, but the 9 European varieties of grape vines may be regarded as unsuitable for this area.

Other Fruits.—

Avocado Pears: 7 varieties—trees growing well.

Mangos: 25 varieties imported from India. Trees growing satisfactorily and appear to be acclimatising.

Litchi chinensis: 3 varieties from India, growing well.

Guavas: 4 Indian varieties. Two of these have produced fruit superior to that produced in this Colony.

Bananas: The Cavendish and Jacquer varieties are doing well. Plants will be available for distribution during 1940.

Pineapples: 5,000 Queen growing and fruiting well. Side shoots will be available for distribution in six months' time.

10 Ghorasal from India.

60 Hen and Chicken (local).

These varieties appear to be identical; the growth is good, but a high percentage of crowns are malformed—selection will correct this fault.

Granadilla: Two varieties planted, but the giant variety failed to germinate. The small Passiflora edulus is producing two heavy crops of fruit per annum.

Nut Fruits.—

Pecan Nuts: Seven varieties planted and first season's growth is very satisfactory.

Japanese Chestnuts: Three trees growing well.

Gashew nut: (*Anacardium occidentale*) failed; climate and altitude unsuitable.

Pachara nut: Two trees making fair growth.

Macadamia ternifolia (Australian nut): One tree survived journey from Natal. Poor growth due to loss of roots in transit.

Berry Fruits.—

Raspberries: Growth good, but canes die back during the dry season; may do under irrigation.

Loganberry: Growth good, but crops poor.

Young berry: Growth excellent and fruit crops very heavy. An extended planting has been made of this promising fruit to test its jam making properties.

Black currant: Failed, climate unsuitable.

Strawberries: Six varieties tested. These have failed to grow with the exception of a variety named Mission Marvel. This variety grows well but fails to bear good fruit crops. Virus disease and mildew were responsible for the failures. Other varieties are to be tested.

Tung Nuts (*Aleurites*).

Several acres have been planted to this oil nut for testing thoroughly. Seeds have been imported from—

Florida, U.S.A.: Cluster type, *Aleurites Fordii.*

China: Cluster type, *Aleurites Fordii,* failed.

Nyasaland: *Aleurites montana.*

China: *Aleurites montana.*

The first season's growth is very satisfactory and shows promise to be a suitable commercial crop for the Eastern districts.

Other Commercial Fruits and Crops.—

Olives: Five varieties, growing well. Trees required to furnish cuttings, etc., for propagation purposes (to test out in the Sabi Valley).

Pyrethrum: Selections made at the Salisbury Experiment Station were planted in the nursery in 1938 then extended to a small commercial trial in 1939. The growth and blossoming has been erratic but fair to good results may be attained under irrigation.

Pelargonium.—One selection of this oil producing plant has been established and is growing well. It appears to be ideal for growing on terrace and contour ridge banks where it smothers weed growths. It produces a valuable oil and a bulky by-product for converting into compost.

Coffee.—Eight strains of two selections of (*Coffea arabica*) have been interplanted in the mango grove; these are doing well, although it was not possible to irrigate them during the past dry season.

Tea (*Thea sinensis*).—Two varieties, Indian and China, are being tested. Growth has been very uneven due to the poor quality of the seed received.

Derris elliptica.—A small planting is under test. The top growth appears to be poor, but this may have little or no bearing on the root yield and quality; the first planting will be ready to lift for examination next June.

Ginger (*Zingibera officinale*).—Grows easily, but hands are poor—may be useful as green ginger. A small commercial planting is now under test.

Arrowroot (*Maranta arundinacea*).—Growth good. small commercial planting now under test.

New Zealand Flax (*Phormium tenax*).—Growth good. Appears to be suitable for binding contour ridges. An excellent fibre plant for local tying material, etc.

Cinchona.—Three species—*C. ledgeriana*, *C. succirubra*, *C. robusta*. Growth good for first season.

Cinnamon (*Cinnamomum zeylanicum*.—Growth good for first season.

Sweet Potatoes.—Nine varieties. Growth and yields in most cases very good; further plantings have now been made to supply planting material to local farmers.

Trees and Crops of Doubtful Value.

Artocarpus integrifolia (Jack fruit).—Growth good, but difficult to transplant.

Annona cherimola (Cherimoya).—Growth fair.

Annona muricata (Soursop).—Growth fair.

Annona reticulata (Bullock's heart).—Growth fair.

Averrhoa carambola (Carambola).—Growth fair.

Abera caffra (Kei apple).—Hedge plant; carries fruit fly.

Achras sapota (Sapodilla).—Growth good.

Canarium commune (Java almond).—Failed.

Casimiroa edulus (Mexican apple).—Growth very strong.

Dovyalis hebecarpa (Ceylon gooseberry).—Possibly good hedge plant.

Durio zibethinus (Durian).—Failure.

Eugenia uniflora (Pitanga cherry).—Failure.

Ephrdea sinica.—Failed. Seedlings damped off.

Feijoa sellowiana (Pineapple guava).—Seedlings growing well.

Garcinia mangostana (Mangosteen).—Failed.

Nephelium lappaceum (Rambutan).—Failed.

Psidium cattleianum (Strawberry guava).—Small trees; grow well.

Spondias cythera.—Failed.

Ornamental Trees.

Mimosa bracitinga.—Growing well.

Populus deltoidea var. missouriensis (Carolina poplar).—Very slow growth for first season.

Eucalyptus saligna.—2,500 trees planted and growing well.

Cupressus torulosa.—For shelter belts; growing well.

Pinus patula.—Growth good for first year.

Sundries.—Several varieties of bamboos have been established, also Spanish reed (*Arundo donax*), all of which are growing well.

A small planting of wheat grass and Vi-Vi was also made early in the year; both appear to be growing satisfactorily.

Rhodesia Weather Bureau.

APRIL, 1940.

PRECIPITATION.

Station.	Inches.	Normal.	No. of days.
Beitbridge	0.07	0.41	2
Bindura	1.56	1.61	1
Bulawayo	0.97	1.73	5
Chipinga	3.95	2.33	11
Enkeldoorn	1.88	0.72	5
Fort Victoria	1.06	0.63	4
Gwaai Siding	2.74	1.38	6
Gwanda	2.14	0.67	6
Gwelo	0.44	0.75	5
Hartley	1.53	0.87	6
Inyanga	1.12	1.23	9
Marandellas	3.67	1.43	7
Miami	1.35	1.39	3
Mount Darwin	0.18	0.52	1
Mount Nuza	3.18	5.19	18
Mtoko	0.06	0.61	2
New Year's Gift	2.85	1.02	8
Nuanetsi	1.01	0.62	4
Plumtree	1.61	1.15	10
Que Que	1.20	0.73	4
Rusape	2.16	1.20	7
Salisbury	2.02	1.05	9
Shabani	0.66	0.60	4
Sinoia	0.45	0.95	8
Sipolilo	0.38	1.19	5
Stapleford	2.58	3.82	16

Station	Inches.	Normal.	No. of days.
Umtali	2.21	1.14	7
Victoria Falls	4.28	0.59	8
Wankie	1.93	0.62	5
Abercorn	0.76	—	5
Balovale	2.41	—	5
Broken Hill	1.55	—	4
Chinsali	0.23	—	4
Choma	2.84	—	5
Fort Jameson	1.67	—	9
Kalomo	3.27	—	8
Kapiri Mposhi	0.85	—	3
Kasama	2.03	—	10
Kasempa	1.45	—	4
Luangwa	1.60	—	5
Livingstone	3.42	—	8
Lundazi	0.61	—	3
Lusaka	2.38	—	5
Mankoya	2.70	—	6
Mazabuka	1.26	—	3
Mkushi	0.02	—	1
Mongu	6.36	—	10
Mpika	0.74	—	7
Mporokoso	1.94	—	15
Mufulira	2.18	—	4
Mumbwa	0.81	—	5
Mwinilungu	1.52	—	9
Namwala	0.84	—	3
Ndola	1.81	—	6
Senanga	1.80	—	4
Sesheke	4.66	—	7
Shiwa Ngandu	0.97	—	6
Solwezi	4.78	—	8

APRIL, 1940

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F.														PRESSURE MBS.			Cloud Tenths.	Sunshine hours.
		8.30 a.m.				Maximum.	Minimum.	Max.+Min.÷2.	Absolute.		No. of Days.				Mean of 24 hrs.	8.30 a.m. Station Level.	8.30 a.m 1200 gdm.	Mean of 24 hrs.		
		Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit				Maximum. Date.	Minimum. Date.	Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°						
Beitbridge	1486	72.5	65.1	61	8.9	86.5	62.0	74.3	97:30	52:12	16	—	9	—	73.6	966.8	885.1	964.7	4.5	—
Bindura	3700	68.3	63.1	60	6.1	79.4	59.4	69.4	85:7	51:29	—	—	2	—	—	—	—	—	4.4	—
Bulawayo	4393	64.1	59.0	55	5.5	76.5	49.8	66.1	83:30	50:29	—	4	—	—	65.0	871.8	883.2	870.3	5.3	7.6
Chipinga...	3685	65.7	61.7	59	4.5	74.8	59.6	67.2	84:30	53:13	—	4	2	—	—	894.5	884.0	—	4 0	—
Enkeldoorn...	4808	63.6	59.1	56	4.8	75.7	55.9	65.8	82:30	50:13	—	4	—	—	—	859.5	883.1	—	5.1	—
Fort Victoria	3571	66.6	61.5	58	5.7	78.4	57.7	68.1	88:30	48:29	2	—	2	—	67.2	898.2	884.0	—	5.3	—
Gwanda...	3233	66.5	61.3	58	5.9	78.4	57.4	67.9	88:30	48:13	3	1	2	—	67.0	908.6	883.6	—	4.6	—
Gwelo	4629	65.3	59.3	56	6.5	76.3	56.3	66.3	83:30	50:28	—	4	—	—	65.0	864.5	883.3	—	4.7	—
Hartley	3879	66.8	61.9	59	5.5	79.1	57.0	68.1	84:26	50:29	—	—	—	—	66.7	887.7	883.2	—	2.5	—
Inyanga	5503	65.4	59.5	56	6.3	73.3	52.1	62.7	79:2	43:30	—	3	—	—	—	—	—	—	3.0	—
Marandellas	5453	62.1	58.2	56	4.0	73.1	52.7	62 9	80:30	49:v.	—	4	—	—	—	—	—	—	4.5	—
Miami	4090	66.4	62.6	61	4.2	77.3	57.9	67.6	83:26	52:30	—	—	—	—	66.1	880.6	882.6	878.9	6.2	—
Mt. Darwin...	3179	68.3	65.6	64	3.2	79.9	60.5	70.2	86:7	54:9	1	—	3	—	—	—	—	—	7.2	—
Mount Nuza	6668	55.5	53.6	53	1.7	61.5	50.7	56.1	68:v.	42:8	—	30	—	—	55.4	803.7	883.5	—	7.2	—
Mtoko...	4136	67.6	62.0	58	6.4	77.0	58.7	67.9	82:7	54:11	—	—	1	—	67.1	880.0	883.6	878.5	3.9	—
New Year's Gift ...	2690	68.2	64.1	62	4.8	81.3	58.6	69.9	90:30	52:30	5	—	—	—	—	—	—	—	—	6.9
Nuanetsi	1547	71.0	64.6	62	7.5	85.7	58.6	72.2	96:30	49:13	15	—	5	—	—	965.0	884.5	—	3.4	—
Que Que...	3999	66.1	61.3	58	5.4	79.1	58.0	68.5	85:2	51:29	—	—	1	—	67.9	883.8	883.0	882.3	4.5	—
Rusape	4648	64.2	59.7	57	4.9	75.4	55.1	65.3	83:30	47:28	—	4	—	—	64.1	—	—	—	5.4	—
Salisbury	4831	64.7	60.2	57	4.8	76.0	55.3	65.6	81:7	50:19	—	1	—	—	64.9	858.4	883.1	857.0	6.3	7.1
Sinoia	3795	67.5	63.2	61	5.0	81.0	56.4	68.7	86:7	48:30	1	—	—	—	—	—	—	—	3.4	—

APRIL, 1940 (continued)

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F.														PRESSURE MBS.			Cloud Tenths.	Sunshine hours.
		8.30 a.m.							Absolute.		No. of Days.									
		Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min.÷2.	Maximum Date.	Minimum Date.	Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hrs.	8.30 a.m. Station Level.	8.30 a.m. 1200 gdm.	Mean of 24 hrs		
Stapleford	5304	60.3	58.0	57	2.3	67.8	51.6	59.7	75:30	42:29	—	19	—	—	59.1	—	—	—	5.8	—
Umtali	3672	65.7	62.4	60	3.7	77.7	59.0	68.4	85:30	51:29	—	2	1	—	66.6	895.0	884.1	883.7	5.2	7.1
Wankie	2569	71.2	66.3	64	6.0	87.5	65.1	76.3	93:16	60:30	23	—	12	—	—	928.6	882.2	—	4.6	—
Abercorn	5458	66.7	61.9	59	5.3	78.5	58.2	68.4	81:v.	57:v.	—	—	—	—	66.1	838.5	881.4	—	4.6	—
Broken Hill	3911	67.9	63.9	61	4.8	79.1	59.4	69.3	85:7	49:30	—	2	—	—	68.1	886.0	882.2	—	6.0	—
Fort Jameson... ...	3815	71.0	65.0	62	7.2	80.4	62.8	71.6	86:7	59:30	1	—	5	—	70.1	889.6	883.2	888 2	3.1	7.6
Fort Roseberry ...	3830	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kasama	—	67.7	63.6	62	4.7	78.9	60.8	69.9	83:8	56·29	—	—	—	—	68.9	865.3	881.7	863.8	4.6	8.5
Kasempa...	4500	63.3	61.7	61	1.6	80.0	56.3	68.1	88:4	40:30	—	—	—	—	—	—	—	—	—	—
Livingstone...	3051	69.1	65.6	64	4.3	83.9	61.6	72.8	89:30	56:3	14	—	7	—	70.9	909.5	882.0	907.9	5.0	7.5
Luangwa Bridge ...	1330	72.5	68.8	67	4.8	88.1	67.6	77.9	94:26	59:30	25	—	21	—	76.6	—	—	—	—	—
Lundazi	3590	69.0	65.5	64	4.2	80.7	57.7	69.2	85:7	49:29	—	—	—	—	68.2	—	—	—	—	—
Lusaka	4193	66.5	62.5	60	4.5	77.3	59.4	68.3	82:7	54:29	—	3	—	—	66.7	876.8	882.1	875.4	5.9	7.5
Mongu	3481	71.1	65.3	63	7.0	82.8	63.6	73.2	88:27	59:20	5	—	8	—	71.9	898.1	881.1	896.8	3.1	8.3
Mpika	4620	66.1	62 7	61	3.9	75.9	60.3	68.1	82:7	54:30	—	2	—	—	66.6	863.8	882.7	—	6.1	—
Msoro	3000	73.1	68.3	66	6.2	87.4	62.9	75.2	91:26	54:29	24	—	8	—	73.4	—	—	—	—	—
Mumbwa...	3500	67.2	63.2	61	4.7	80.8	60.7	70.8	85:4	52:30	—	—	4	—	69.8	—	—	—	—	—
Mwinilunga...	4450	66.8	63.9	62	3.3	79.1	57.4	68.3	82:v.	50:v.	—	1	—	—	—	—	—	—	—	—
Ndola	4190	66.3	63.3	62	3.5	80.2	58.8	69.5	83:1	52:30	—	—	—	—	68.6	877.0	882.0	875.2	4.2	—
Chileka	2600	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Southern Rhodesia Veterinary Report.

APRIL, 1940.

DISEASES.

Anthrax was diagnosed on Pimento Park farm in the Mazoe native district, and on Sewerage farm in the Salisbury native district.

TUBERCULIN TEST.

Thirty-two bulls, fifty cows and nine heifers were tested on importation. There were no reactions.

MALLEIN TEST.

Eight horses and ten mules were tested with negative results.

IMPORTATIONS.

From Union of South Africa.—Bulls 32, cows and heifers 59, horses 8, mules 10, pigs 1, sheep 1,478.

From Bechuanaland Protectorate.—Slaughter cattle 257, sheep 481, goats 92.

EXPORTATIONS.

To Belgian Congo.—Cows 50.

To Portuguese East Africa.—Oxen 122.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

To United Kingdom: Beef quarters (chilled quality), 11,230; boneless beef quarters, 1,874; tongues, 19,132 lbs.;

livers, 35,019 lbs.; hearts, 10,861 lbs.; tails, 9,772 lbs.; skirts, 6,318 lbs.; shanks, 3,768 lbs.; cheeks, 2,039 lbs.

To Northern Rhodesia: Beef carcases, 52; offal, 3,615 lbs.

To Belgian Congo: Beef carcases, 106; mutton carcases, 16; offal, 240 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa: Corned beef, 196,872 lbs.; beef fat, 36,600 lbs.; beef paste, 3,481 lbs.; tongues, 2,190 lbs.; sausages, 10,371 lbs.

B. A. MYHILL,
Chief Veterinary Surgeon.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than stamps.

A 10/- note will cover the subscription for two years.

Persons residing outside Southern and Northern Rhodesia may become subscribers by paying 2/- in addition to the subscription, to cover postage.

If payment is made by a cheque drawn on a bank outside Rhodesia, commission must be added.

All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

Date...194......

To the Secretary,
Department of Agriculture and Lands,
Salisbury.

Please enrol me as a subscriber to the "Rhodesia Agricultural Journal" for one year from..

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THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the staff of the Agricultural Department.)

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

VOL. XXXVII.] JULY, 1940. [No. 7

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, *Salisbury.*

Appeal to Farmers.—There are three vacancies for the temporary post of Grain Inspector under the Department of Agriculture. Difficulty is being experienced in finding suitable men to fill them.

It is thought that some farmers might be able to perform this essential service for the short period (mid-July to October) during which the grading of maize is carried out.

Those willing to undertake this work are asked to apply to the Secretary, Department of Agriculture and Lands, Salisbury, for particulars of pay and duties as early as possible.

Reminder for Tobacco Growers.—The fertiliser companies recently issued a warning that, in consultation with the Controller of Supplies, all tobacco growers had to place their orders for fertilisers not later than 15th July, 1940. It was also stated that no tobacco grower would be permitted to purchase more fertiliser than was used by him in the 1939-40 season. When computing their requirements growers are asked to deduct any stocks on hand from their order.

Grass Protects the Soil.—The following note taken from an article in a recent number of "Soil Conservation" contains some very interesting figures regarding loss of surface soil under rainfall conditions similar to our own.

"There is danger in forgetting that grass is largely responsible for making the crop land productive. The farmer who will plan a long-time grass rotation, to permit all of his land to rest part of the time while it is seeded to grass and used for pasture, can maintain soil fertility more easily and effectively than the farmer who attempts continuous cash-crop production.

"How does pasture, or the growing of grass, function in building soil? In the first place the soil must be stabilised and held in place before it can accumulate and retain fertility. It has been repeatedly shown that grass is one of the best soil stabilisers we have. At Zanesville, Ohio, the Soil Conservation Service Experiment Station found that bare ground in corn or fallow lost from 35.2 to 42.5 per cent. of the total rainfall, while bluegrass lost only 4.5 per cent. It is interesting to note that the grass made possible the infiltration of practically all the rainfall. This fact, however, is not nearly so important as is the 'holding power' of bluegrass or other grasses. Land in continuous corn, at this Station, lost 59.6 tons of soil per acre per year as a result of run-off, whereas grass lost only 100 pounds of soil per acre. On the above basis the 7 inches of fertile topsoil, if planted to corn each year, would be completely gone in 19 years; and on the other hand, were the same land kept in bluegrass 23,200 years would pass before the same amount of soil would be lost. These results were obtained on a 12 per cent. slope in an area that received 34.5 inches of rainfall per year; such results show how grass holds the soil."

Livestock Improvement Scheme.—Stock farmers are advised that applications for assistance towards the purchase of stock in terms of the above-named scheme during the current financial year ending 31st March, 1941, should be submitted to the Secretary, Department of Agriculture and Lands, P.O. Box 387, Salisbury, as soon as possible *and not later than 31st July*. In view of the present situation it is necessary to exercise every possible economy and applications submitted after the 31st July, will only be dealt with if funds are available and if the necessary inspections can be arranged economically with the limited staff now available.

The conditions of the Livestock Improvement Scheme follow more or less the lines of the Scheme in operation in previous years. Facilities are provided in approved cases for both an outright grant and a loan towards the purchase of good sires and, in certain circumstances, similar assistance may be given towards the purchase of pure-bred female stock.

The Scheme applies to cattle, sheep and pigs and stock farmers are urged to make the fullest possible use of the facilities available. Full particulars may be obtained from the Secretary, Department of Agriculture and Lands.

It should be clearly understood that applications are not carried forward from year to year and any applicants who applied under last year's scheme (*i.e.*, prior to the 1st April, 1940) and who did not take advantage of any grant approved must re-submit their applications for consideration in terms of the current scheme.

Breeders who have bulls, rams or boars for sale, which are likely to be suitable for use under the Livestock Improvement Scheme are asked to send particulars of the animals for sale, as they become available, to the Secretary, Department of Agriculture and Lands.

Animals bred in Southern Rhodesia on which grants are to be claimed must be approved and marked prior to purchase by the applicant. Departures from this rule will only be made in special cases and when the necessary inspection can be arranged without undue expense.

Charge for Bulletins.—Attention is called to the fact that it has been decided to revert to the previous arrangement whereby all Departmental Bulletins must be paid for. This will come into force from July 1st and the charge will be 3d. per copy to residents in Southern Rhodesia and 6d. per copy in all other cases.

Special terms will be arranged for Government institutions, schools, etc., when ordered by official requisition.

Copies of these Bulletins may be obtained from the Editor, Box 387, Salisbury. To residents in Southern Rhodesia the charge is 3d. per copy. In all other cases 6d. per copy is charged and all orders must be accompanied by remittance, otherwise they may be ignored.

One Crop of Granadillas Pays for Fence.—On the Subtropical Experiment Station at Umtali a fence was erected along a roadside just over a quarter of a mile long, 1,350 feet. The standards are 30 feet apart and a granadilla plant was put at each post. During the last year there have been two crops of fruit which was sold to a factory in Umtali at a penny per pound. The second crop is not quite finished, but 5,259 lbs. have been sold realising the sum of £21 18s. 3d. Each yard of fence has averaged about 6 lbs. of fruit for each crop, i.e., 1s. per yard during the year.

Import and Export of Foodstuffs Prohibited.—In the exercise of the powers conferred upon him by section (1) of Government Notice No. 302 of 1940, the Minister of Agriculture and Lands hereby orders as follows:—

(1) These Orders may be cited the Agricultural Products Importation and Exportation Prohibition Orders, 1940.

(2) On and after the 21st day of June, 1940, no person shall, except under permit granted by the Minister of Agriculture and Lands, export, attempt to export, or cause to be exported from, or import, attempt to import, or cause to be imported into the Colony any of the undermentioned agricultural products:—

- (*a*) Maize and maize products;
- (*b*) beef or beef products;
- (*c*) butter;

(*d*) eggs;

(e) cheese;

(*f*) pigs, bacon or pig products;

(*g*) ground nuts;

(*h*) sunflower seed.

Provided that a permit shall not be required for the export to any individual of consignments, not exceeding weekly, of—

one bag maize or maize products;
seven pounds beef or beef products;
four pounds butter;
three dozen eggs;
four pounds cheese;
seven pounds bacon;
one bag ground nuts;
one bag sunflower seed.

(3) Any person who contravenes section 2 of these Orders shall be guilty of an offence and liable on conviction to a fine not exceeding £50, or to imprisonment for a period not exceeding three months, or to both such fine and imprisonment.

Cleanliness and Labour.—The suggestion is sometimes heard, and apparently not without some justification that, although agricultural cleanliness is undoubtedly of very great value, the labour position is a factor against its proper attainment. Whilst this is so, it is no valid reason for not doing as much as possible under individual circumstances All attempts are made to make a sick man comfortable and to cure him with what remedies are at hand, pending the arrival of something better. Frequently nothing more is needed. Similarly we should do what is possible with available labour to cure the ailing condition of a farm that harbours crop refuse and weeds and other dangerous plants. To ignore it is to intensify the trouble.

The development of a habit of agricultural cleanliness in what labour we have is an excellent start. We should aim at making this habit as strong as the native's present habit of preserving the self-sown pumpkin plant that persists in the precincts of his kraal. When native labour on the farm becomes cleanliness-minded as regards agriculture, the battle is half won. It is possible to visualise a bright future in which the natives of the whole country have the habit of agricultural cleanliness.—*Cleanliness Aids Insect Control.*

Soil Acidity.—The following explanation of the measure of soil acidity is taken from a recent number of the *Queensland Agricultural Journal*:—

"The term pH is now so commonly heard or read that it is to the farmer's advantage to understand, not merely that a pH value indicates in some way the acid, neutral or alkaline condition of the soil, but to have also some knowledge of the meaning of the value and the theory on which it is based. The following explanation, it is hoped, will assist in this direction:—

Acids contain hydrogen combined in their molecules. In solution (as in the soil) the molecules of acids, alkalis and salts break up (or dissociate) to a certain degree to form ions. The ion common to all acids and on which acid properties depend is the hydrogen ion. Now different acids containing *similar amounts of hydrogen in combination* dissociate to different extents to give *different amounts of hydrogen ions in solution.*

Take two acids for instance—acetic acid and hydrochloric acid. The amounts of acid present may be the same, and may be neutralised by the same amount of alkali, such as caustic soda, and yet the actual degree of acidity or intensity of acidity would be far greater in the case of the hydrochloric acid, because at the same concentration it is dissociated into ions to a far greater extent and make "available" far more hydrogen than the acetic acid.

These hydrogen ions may be considered as "free" or "active" hydrogen, and are termed potential hydrogen—from which the term pH is derived.

The figures used to denote pH are based on the volumes of different solutions that would contain a set weight of hydrogen ions. The scale ranges from 0 to 14, and as the greater the volume required the lower the concentration of hydrogen ions; acid solutions are indicated by low figures and alkaline solutions by the high figures.

pH 7 is neutral—the pH of distilled water. On account of the system used in obtaining the pH, a decrease in 1 unit on the scale indicates an increase of ten times, and a decrease of 2 units indicates an increase of 100 times the acidity. Conversely rises in pH indicate decreases in acidity to the same extent.

From the foregoing it will be appreciated that the pH (potential hydrogen) of a soil is an indication of the concentration of hydrogen present in ion form in the soil solution. It should not be confused with the amount of acids present in the soil—as indicated by titration against an alkali—as only portion of these acids are dissociated into ions and, consequently, they may be said to have much of their power not available.

The following guide to the interpretation of values is given:—

pH 4.0 to 4.7—Very strong acidity.
pH 4.7 to 5.2—Strong acidity.
pH 5.2 to 5.8—Medium acidity.
pH 5.8 to 6.4—Moderate acidity.
pH 6.4 to 7.0—Slight acidity.
pH 7.0 —Neutral (pure water).
pH 7.0 to 7.5—Slight alkalinity.
pH 7.5 to 8.2—Medium alkalinity.
pH 8.2 to 8.5—Strong alkalinity.

Beyond these limits cultivation is not normally possible.

From the foregoing it will be seen that only a small portion of the pH scale is used in actual practice."

Experiments carried out a few years ago at the Virginia Experiment Station show that certain crops favour strongly acid soils, *e.g.*, potatoes, sweet potatoes and watermelons. Those which grew best on medium acid soils included beans, cabbage, carrots, cauliflower, cucumbers, egg-plants, parsley, pumpkins, radishes, strawberries and tomatoes. The following did best on slightly acid soils: Asparagus, beetroot, celery, lettuce, onions, peas and spinach.

It is interesting to note the amount of lime which was required to bring soil having a pH value of 4.7 to a higher pH value. Thus 926 lbs. per acre brought the soil to pH 5.3; 2,778 lbs. per acre to pH 6; 4,630 lbs. per acre to pH 6.6, and 7.408 lbs. per acre to pH 7.

Although it was found that potatoes were less troubled by certain diseases when grown in very acid soil, it was found that the maximum yield was not obtained if the pH of the soil was below 5; thus when grown on a soil with pH 4.5 the average yield in bushels per acre was only 169, but when 200 lbs. of lime was added per acre the pH value rose to 5.1 and the average yield per acre to 239 bushels, an increase of 29 per cent.

"Kromnek" Photographs in Last Issue.—It is regretted that, owing to an oversight, acknowledgement was not made in the June *Journal* concerning the two illustrations used in the Mycological Notes. These were kindly supplied by the Union of South Africa Department of Agriculture, to whom we have been indebted for so many kindnesses.

Horsesickness Inoculation.—Vaccine for the inoculation of horses and mules of any age against horsesickness will be issued from now onwards until the end of November at a cost of 6/- per dose, post free.

Immunity does not reach its height until some months after inoculation, and owners are therefore urged not to defer inoculation until the end of the season.

The vaccine must be used within seven (7) days of its despatch from the Laboratory, and will be issued direct to applicants, who will be required to do or arrange for the inoculation themselves.

Directions for use will be supplied with the vaccine.

Applications, in writing, and enclosing the cash remittance, should be made to:—

The Director of Veterinary Research,
P.O. Box 657,
Salisbury.

Orders will be dealt with strictly in rotation and according to the supplies which may be available at the time.

Applications will neither be acknowledged nor considered unless they are accompanied by cash (6/- per dose) and received by the 20th November.

HORSESICKNESS VACCINE.

Price: 6/- per dose.	Inoculate now.
Closing date for applications: 20th November.	Use within one week of its issue.

The Effect of Fish Meal on Turkeys.

By the Poultry Branch.

Experiments which have been completed on the fishy flavour in turkey meat will be of interest to those raising turkeys for market. It had been found that cod liver oil in the ration caused fishy flavours in chicken meat. This was then extended by experimentalists to determine the effects, if any, of fish meal in the ration fed to turkeys. It was found that the feeding of either 1% cod liver oil or 10% of vacuum dried white fish meal, or both, resulted in a fishy flavour and odours detected even in the roasted carcases of turkeys that had been fed during their entire growing period. More recently the results of other experiments concluded at the Virginia Institute show the length of time fish meal must be withheld from the turkeys before slaughtering in order to eliminate the fish flavours and odours from the meat.

A basal ration was used:—

1. With 20 lbs. flame dried fish meal.
2. 10lbs. fish meal, 10 lbs. meat meal.
3. 20 lbs. meat meal.
4. 20 lbs. steam dried fish meal.

For the first 8 weeks all the young turkeys were fed on a basal rearing ration and after this period all the groups were changed to an "all mash" growing ration with the animal protein constituents shown above.

To determine the length of time that fish meal must be withheld from the turkeys before slaughter in order that the fishy flavour of the meat may disappear, all the fish in the rations was replaced with an equivalent quantity of meat meal when the birds were 21 weeks of age. A grain mixture was also fed *ad lib.*, beginning at the same time. A male and female bird was taken from each group at intervals of two weeks, slaughtered and cooked and tasted by a number of people to note the degree of fish flavour perceivable in (1) breast meat, (2) the thigh meat, (3) the dripping, and to record their findings under the headings none, slight, medium or pronounced as the case might be. The tasters were not aware of the feeding of the various groups. In general the flesh of the females did not exhibit as strong a fishy flavour as did that of the males from the same pen. The fishy flavour disappeared from the females after fish meal had been removed from their ration for a period of four weeks, while it required a period of eight weeks to eliminate the undesirable flavour from the flesh of the males. In all instances the strongest fishy flavour was found in the dripping.

It was found that reheating the meat after it had been cooked resulted in a strong flavour of fish and in some cases the flavour was only detected in the reheated meat by all who tasted it.

From the results of these tests, it is stated, it would seem that no fish meal should be fed to turkeys for a period of at least eight weeks prior to slaughter in order to be certain that the flesh will be free of fishy or other undesirable flavours. There was no marked difference in the flavour of the meat of the birds that nad been fed steamed dried fish or flame dried fish meals.

Fishy flavours were detected in the roasted carcases of turkeys that received 10% or more of fish meal in their ration. It required a period of four weeks after all fish meal was omitted from the ration to remove all traces of fishy flavour from the birds fed 10% fish meal and 10% meat meal. An eight week period, after fish meal was omitted from the ration, was necessary to remove the objectionable flavour from the flesh of those birds that had received 20% of fish meal. The meat of all the males exhibited a slightly stronger fish flavour than did that of the females.

On the basis of this work authors have formulated the following suggestions to govern the feeding of fish oils and fish meal to turkeys:—

1. Feed fish oils if necessary during the starting period only. In any event, fish oils should not be included in the ration for the period of at least eight weeks immediately prior to the marketing of the birds.

2. Unless there is a favourable price ratio between fish meal and meat meal the former should not be included in the turkey ration. If used it should be omitted from the ration for a period of at least eight weeks before the birds are to be slaughtered.

Farming Calendar.

AUGUST.

FORESTRY.

Seed beds may be prepared and eucalypt seeds sown if required for planting early in the season. Make sure that all fireguards are in order.

CROPS.

Prepare your compost heaps. Grade the potatoes properly according to size. The buyer wants potatoes—table or seed—of even size, not large and small mixed. Select and clean farm-grown seeds ready for next season's planting. Label the bags with name and weight of contents. Build a proper shed for your seed potatoes. Sort over seed potatoes in store and remove any diseased or rotten. Green oat or barley fodder on wet vleis, or under irrigation, will become ready for cutting. Press on with ploughing and cross-ploughing. Decide what crops are to be grown next season, and, if you think fit, discuss the matter with officers of the Department of Agriculture. If you have not already effected all your purchases, consider the question of what seed you will require to buy for next season. If in doubt, consult the Department of Agriculture. In frost-free situations, potatoes can be planted for an early crop under irrigation or on damp land. Cart and spread your farmyard manure and plough it under as soon as spread to avoid loss. If you have any long stable manure, apply it to your heaviest land. The application of fertilisers to the land can continue. If you do not already have one, put up an implement shed, even if it be only poles and grass. Keep wagons and Scotch carts under a similar shed or in the shade of trees. Speed up the making and burning of bricks if this is still in progress.

STOCK.

Cattle.—On the early granite and sand veld probably the worst of winter is over so far as grazing is concerned, and a nice bite of green grass is appearing. Care should be taken where cattle are allowed to graze on the early burnt grass not to let them get too much at first. On red soil farms the haystack will still be required, and in all cases a certain amount of hay or ensilage should be held in reserve against the possibility of very late rains. In dairy herds on any soils whatever, feeding, housing and bedding should not be relaxed.

Calves, especially young ones, must be carefully watched; they should not run too far, and are better inside, except when the weather is warm. They should be fed a little sweet hay, bean meal, linseed, ground nuts or ground nut cake and a small ration of green food.

This is usually a critical time of the year for young dairy stock. For dairy heifers, weaned calves, etc., there is possibly no better ration than one consisting of maize silage, legume hay and small allowance of mixed concentrates, and these feeds, if supplied in liberal quantities, should serve to keep the young stock in a thrifty, growing condition.

Sheep.—In many places there will be grazing on early burns, see that the ewes and lambs get the best. In the drier parts this is one of the most critical months. A stack of bean hay and a little maize will solve most of the troubles.

DAIRYING.

No difficulty should be experienced in producing first-grade cream at this time. In cold, windy weather due precautions should be taken to ensure that the milk when separated is not below 90 degrees.

Most cheese-makers cease their cheese-making operations at the end of the month, as milk is usually scarce. Cheese in the store-room should be carefully watched, as cheese mite is likely to appear on old mature cheese. In order to prevent the undue drying out of the cheese, the floor of the cheese room should be sprayed with water from a watering can.

VEGETABLE GARDEN.

Plant out asparagus, cabbage, cauliflowers, onions and early potatoes. Sow seeds of tomato and other plants that are susceptible to frost in a sheltered position; also seeds of various vegetables and salads for summer use.

POULTRY.

By the end of this month all those who are not able to give much attention to the chicks while in the growing stage should have stopped hatching. Those who can give some extra care, can continue hatching for another month, but not later, for chicks hatched after August are usually slow in growth and weedy. They do not lay till some months after they should, and eggs are few in number; in fact, they are generally unprofitable.

Now that the hot weather is approaching, a constant war on insects must be carried out, and of these sand fleas and fowl ticks (erroneously called tampans) will be found to be the most troublesome. A bulletin on fowl ticks can be obtained upon application to the Poultry Officer, Department of Agriculture. Sand fleas, as most poultry keepers know, are found on the face, wattles, ear-lobes and combs of the birds. Application of carbolised vaseline will usually kill them at once, or two or three applications of any ordinary grease on successive days are efficacious. More than this is, however, necessary, for the breeding quarters of these insects (and they multiply very rapidly) are in the dust on the floor of the house and that of the run.

The best preventive is a hard floor (preferably of concrete) with no cracks. If this is not possible, the floor around the house should be treated every week in one of the following ways: (1) Thorough soaking with a solution of one teacupful of Kerol, Jeyes, Hycol, Izal, or similar disinfectant to a paraffin tin of water, or (2) with a strong solution of salt and water, or (3) dusting over and raking into the soil a mixture of one part flowers of sulphur and two parts finely powdered lime.

Ducks.—See that the breeding ducks have plenty of water, and if possible also some to swim in. Keep young ducklings out of the hot sun, otherwise there will be many deaths. The same applies to geese and goslings.

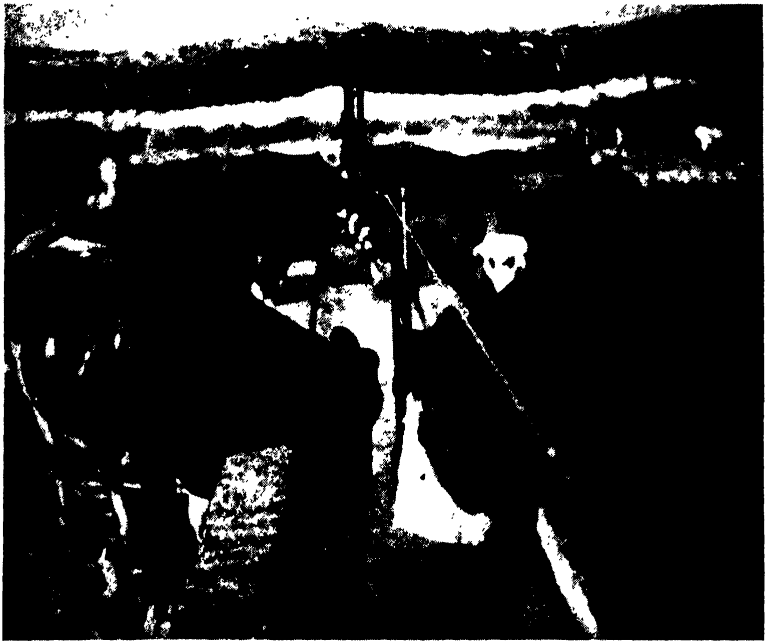
Turkeys.—Young turkeys must be protected from cold at night, for this is fatal to them. Give them as much free range as possible, and do not allow them to run round the house or on the same ground as fowls do. Turkeys like clean ground; any that is tainted is very detrimental to them. Let them find most of their food in the bush.

TOBACCO.

The seed bed site should be cleared and well ploughed, preparatory to burning and sowing. The usual date of sowing the first beds is the 15th September. Bulletins covering every phase of tobacco culture can be had upon application to the Editor.

VETERINARY.

Redwater and gall-sickness occur all the year round, although these diseases are more prevalent during the summer months. A good many deaths occur this month, however, amongst imported stock. Vegetable poisoning will probably be in evidence. Sheep can be inoculated against blue tongue. Scab is a poverty winter disease.



Bullocks being fattened on the Gatooma Cotton Station.

Some Hints for Cotton Growers.

By G. S. Cameron, Empire Cotton Growing Corporation.

The following notes are given in the hope that they will be of interest and possibly helpful to new cotton growers.

The notes are based partly on experience gained on the Cotton Breeding Station, Gatooma, and partly as a result of numerous talks and discussions with experienced cotton growers in various parts of the country. Here it may be stated that what is learned from the experience of others is quite often as useful, sometimes even more so, than what one learns from operations on one particular place situated in one part of the country.

The question as to whether a farmer should grow cotton or not is one which he must answer for himself. It is the writer's conviction that many more farmers ought to be growing cotton than are doing so, but it is difficult to overcome prejudice against a crop which did not come up to the extravagant expectations that once were, rather foolishly, held about it.

Those who have been growing cotton regularly over a period of years know by experience that the crop is a payable one, although in years of low prices the cash return may not be great. It is as a rotation crop that its benefit is most noticeable, especially with maize. There is also the value of the cotton seed for fattening cattle and the grazing value of the cotton plants after the crop has been harvested.

Cotton as a Rotation Crop.—For a number of years farmers have been remarking on the distinct increase in maize yields following cotton, and this has been very marked on the Cotton Station at Gatooma. It used to be the practice to alternate maize and cotton, and latterly maize following composted cotton. The increase in maize yields has been so manifest that an attempt is being made to assess what this rotational benefit amounts to in the increased number of bags of maize per acre. It is not an easy matter, because the last two seasons have been particularly favourable to maize on the Cotton Station, and one naturally hesitates to make claims for cotton as a rotational crop when it has been helped by unusually favourable climatic conditions. It is worth mentioning that the increase in maize yields following cotton has been noted in the majority of maize producing districts as well as in Matabeleland and Northern Rhodesia. Just why cotton should be such a good rotation crop is still a matter for speculation. There are a number of reasons put forward, and these may be quite sound, but no definite claim can be made for any of them until fully investigated, and that may take some time yet. It may be that the beneficial effects are not due to any one particular factor, but to a combination of several. For the time being it is sufficient to know that the benefit does exist, and academic investigations as to why and wherefore will have to wait.

Choice of Land.—Cotton is very tolerant in the matter of soil, but it cannot grow properly where there is any tendency for soil to become waterlogged. Put in another way, COTTON CANNOT STAND WET FEET. It is very necessary to stress this fact in block letters, because it is a point which new growers fail to appreciate until it is too late, and then they blame the cotton. Even poor land, provided it is well drained, will produce a cotton crop, but this is not to say that cotton prefers poor land, it does not. On the other hand, it is not economic to put it on rich soil which would give a better financial return under other crops. A number of maize growers have made a practice of planting cotton on land which has ceased to be sufficiently productive for maize. By this means they are enabled to get another maize crop off the land before putting it under green manure. This is merely an expedient, as it is not claimed for cotton that it takes the place of green crop ploughed in. It is better to plant cotton before land has become too worn out, and add a dressing of farm compost, say five tons to the acre. Not only will this ensure a good cotton crop, but it is also a sure method of obtaining at least two good maize crops following the composted cotton.

Preparation of Soil.—As cotton requires to be planted early, it is necessary to have the land well prepared to ensure a good seed bed. If the land is disc harrowed immediately after ploughing in the autumn, it should be possible to dry plant the cotton if planting rains threaten to be late. It is necessary here to utter a word of caution against planting "too" early. Supposing planting rains arrive early in October, as sometimes happens, it would be risky to plant cotton then, as the seed would germinate, but there is always the risk of a drought after early rains, and the young seedlings might die off.

As a rule it is better to wait until the first or second week in November.

Perhaps it might be as well to explain that the necessity for early planting is not so much on account of falling temperatures in the autumn, but in order to get early flowering. The earlier the flowering the less damage is there likely to be from bollworms. In some ways "bollworm" is a misnomer. The American bollworm is the same pest as the "Top grub" in maize, or the tomato worm, or the worm that does so much damage to citrus. In the case of cotton the greatest amount of bollworm damage is done during the flowering period. If it is remembered that every cotton flower is a potential boll, then we can realise the necessity for getting the greatest number of flowers produced and fertilised before bollworm attack reaches its maximum.

Planting.—There are two outstanding points in connection with the planting of cotton: (1) Do not plant too deep, and (2) use plenty of seed. The first point is stressed because it sometimes happens that, after the seed has been planted, there may be a heavy tropical downpour of rain which batters the surface of the soil, and this dries into a hard crust if the rain is followed by a spell of hot dry weather. This happens more frequently than is generally recognised, and it is on this account that shallow planting is strongly recommended. If planted too deep the seed may germinate, but the young seedlings will not be able to push their way to the surface and break the crust which has formed. For the same reason it is necessary to use plenty of seed. The seed rate generally recommended is about 25 lbs. to the acre for machine planting and about 15 to 20 lbs. if planted by hand, and dropping 4 or 5 seeds per hole.

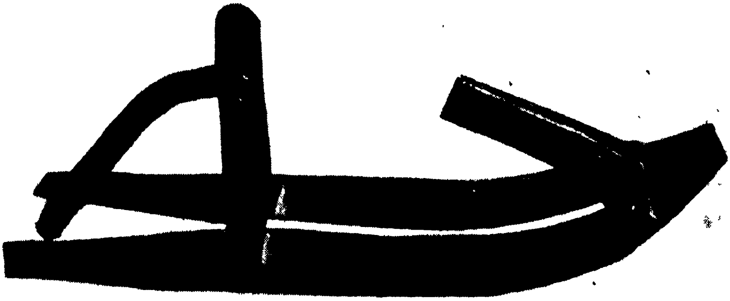
Depth Regulators.—The use of depth regulators or shoes is strongly recommended. These are attached to the planter and prevent it from sinking too deeply into the soil. Depth regulators are obtainable from agricultural machinery merchants in Bulawayo and Salisbury, and are sound investment, especially on light, sandy soils.

All cotton seed issued for planting is delinted at the Ginnery before despatch to growers. A cotton planting attachment should be used, but it is necessary to keep a watchful eye on the seed shute to see that the seed is being delivered evenly and regularly from the seed hopper. Even with the closest delinting there is always danger of cotton seed "bunching" and creating a jam or block in the delivery.

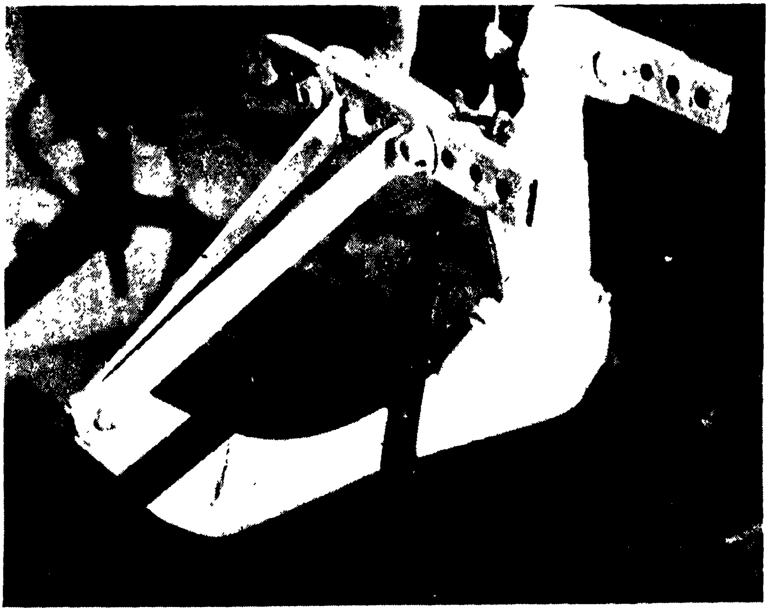
Seed Treatment.—Sometimes one hears that it is advisable to treat cotton seed by rubbing it in puddled soil and then leaving it in the sun to dry. This is said to have the effect of making the fuzz on the seed stick to the seed coat, thus allowing it to pass more easily through the machine. Such is not the writer's experience. When this method was tried out it did not work according to expectations, and had the additional disadvantage of introducing sand and grit between the cog wheels. If the seed is to be treated, it is much better to use a paste made of cattle dung. This worked effectively and did not have the disadvantage mentioned above.

Thinning Out or Singling.—If planting has been properly carried out, and if the weather conditions have been favourable, the young seedlings should begin to appear above ground after four to six days. By the tenth day the young plants should be distinctly visible in clearly defined rows. By the time the young plants are about four to six inches high they should be thinned out (singled) to approximately one plant at intervals of six inches apart. If the land is dirty with weeds it would be advisable to put the cultivators through before thinning.

Cultivating and Weeding.—The number of cultivators required will depend upon the cleanliness of the land or otherwise. Some farmers find it possible to thin out and hand weed at the same time. Others maintain that this is not possible, and prefer to make two operations of what should



One of a pair of depth regulators for cotton planting machine.



Method of attaching depth regulator to planter.

be carried out in one. It seems to depend upon the labour, and to a greater extent, how it is supervised.

The number of subsequent cultivations depends as already stated on the cleanliness of the land. One hand cultivation and two or three cultivations with the cultivator should be sufficient, normally, but it should be remembered that cotton offers an opportunity of getting land thoroughly cleaned. Care should be taken that the cultivators are not set too wide. It is the early cultivation that matters, and if cotton is kept clean from the start there should be less need for subsequent cultivations.

Early Growth.—In the early stages cotton does not grow quickly, and this should be noted by farmers who grow the crop for the first time. At the beginning of the season the young plants are getting their roots well down into the soil, and it is not until they have done so that they begin to grow vigorously above ground.

Fertilisers.—The use of artificial fertilisers on cotton is not recommended. In Southern Rhodesia the surface application of artificial fertilisers to cotton produces no response, even when heavy dressings are applied. It is thought, and it may well be, that cotton, being a deep rooted plant, gets the residual benefit of fertilisers applied to previous crops. If the farmer wants maize to follow his cotton crop, then he could apply raw rock phosphate to the cotton, but it is the subsequent maize crop and not the cotton which would derive the benefit.

Compost.—While cotton does not respond to artificial fertilisers, it shows a marked response to applications of farm made compost. Various dressings have been applied to find out which is the most economic. So far it would appear that applications in the neighbourhood of five tons of compost per acre are the most economically effective. Composted cotton seems to get away much quicker at the beginning of the season, and the benefit of the compost is most marked in a year of severe drought periods. Compost has a definite effect in increasing the yield per acre. All this has been very clearly demonstrated on the Cotton Breeding Station at Gatooma. So much so, that the fattening of steers as chillers, has now become part of the farming operations in order to get a sufficient supply of dung and urine to convert the farm waste material into compost. The compost is spread on the land and ploughed in, but it is not possible as yet to say whether it would not be better to apply the compost a little before planting time and harrow it in, either with disc or drag harrows. It is intended to test the latter method next season in a series of replicated trials.

Bulletins giving instructions for the manufacture of compost are obtainable from the Department of Agriculture in Salisbury, and short notes are to be found in "The Rhodesian Diary and Businessman's Calendar."

Harvesting.—When the first cotton bolls begin to open towards the end of April or beginning of May, according to whether the crop was planted early or not, it is then advisable to look into the crop and see whether it is likely to be a heavy one. One can judge this by the number of full grown but unopened bolls on the plants. If the plant is carrying well formed bolls up to the full length of the plant the chances are that the crop will be a heavy one and may necessitate two or even three pickings. In Southern Rhodesia, however, it is seldom necessary to pick more than twice, and more often than not one picking will be sufficient. If there has been heavy bollworm attack when the top flowers were forming there is not likely to be much of a top crop. When this happens it is as well to make one picking only and wait for all the bolls on the plant to open. If it is an early season this may take place about the end of May or the beginning of June.

Native labour in Southern Rhodesia does not seem to adapt itself readily to cotton picking, and not many boys bring in more than 40 lbs. seed cotton per day, except when the crop is an exceptionally heavy one.

With natives who have not had previous experience in picking cotton it is as well to let them practice for two or three days, under supervision, before setting their daily task. If the crop has grown tall and rank, picking is more difficult and allowance should be made accordingly. Short, heavy bearing plants which have shed most of their foliage, are the easiest to pick, and under such circumstances the task can be increased.

Packing and Sale.—Small quantities of cotton can be sent to the Ginnery in sacks, about 50 lbs. seed cotton per sack. Larger crops should be packed into woolpacks. If well trampled in it is possible to get as much as 500 lbs. seed cotton into a woolpack. The ideal quantity is about 450 lbs. seed cotton per woolpack. More than this quantity means tighter packing, which renders the packs more likely to burst along the seams when dropped from wagons or railway trucks.

Farm Costs per Acre.—It is difficult to give definite information about the cost of farming operations because these vary from district to district and from farm to farm. So much depends upon the cost and efficiency of the native labour employed and upon the ability of the farmer to get the best out of his labour. The following costs are taken from the records of the Cotton Station, and are given merely as an indication. They agree fairly closely with costings given by cotton growers in various parts of the country, including Matabeleland, but that is not to say that they are above criticism. In fact, criticism is always welcome, not only in regard to costs of farming operations, but in any matter connected with the furtherance and welfare of the cotton growing industry.

Costs per Acre of Machine Planted Cotton—Farm Costs only.

	£	s.	d.
Ploughing	£0	3	0
Harrowing	0	0	4
Planting (includes cost of seed)	0	2	2
Hoeing and Cultivating	0	3	9
Singling (Thinning)	0	2	3
Picking	0	10	5
Uprooting, raking and hauling plants to compost heap	0	1	3
Upkeep and depreciation on implements	0	3	0
Compost. 5 tons per acre @ 3s. 6d. per ton 2s. 3d. the value for first year effect	0	11	8
Hauling and spreading compost	0	1	4
	£1	19	2

Insect Pests.—The following notes are reprinted from Bulletin No. 994 "Some Notes on Cotton Growing," by J. E. Peat, September, 1936.

There is little to add to these notes since they were written, but it may be emphasised that the strains of cotton which are being issued now are even more resistant to jassid than were those of four years ago, and the danger from Sudan or Red Bollworm has been lessened materially by the prohibition of ratooning or the leaving of old cotton plants in the field from one season to the next.

Under the Cotton Pest Prevention Act it is necessary to have the cotton plants uprooted by a date specified in the *Government Gazette.* This date is usually fixed for the first day in October, but may in time be extended if circumstances warrant an alteration of the date.

There are four main pests of cotton in Southern Rhodesia —Jassid, American Bollworm, Sudan or Red Bollworm, and Stainer. Without these pests cotton growing would be relatively simple.

Jassid.—Is a small plant sucking bug which, as far as is known, in feeding injects a poison into the plant. This destroys the green colouring substance in the leaf and thus interferes with the growth of the plant. It has been found that plants with hairy leaves are unfavourable to jassid and are thus resistant to attack. The seed stocks at present available have a fair degree of resistance, allied to other good qualities, such as earliness and free fruiting habit. It is only in exceptional years that the strains at present being grown will suffer from much jassid. Newer strains with greater jassid resistance are being bred up at Gatooma, and in a year or two will be available to all growers.

American Bollworm.—At present in this country American Bollworm is the most serious pest to cotton growing. The moth lays eggs on a wide range of plants while they are at the flowering stage; the caterpillars which hatch out from these eggs feed freely on the buds, flowers and fruits. Maize, beans, tobacco, kaffir corn, etc., are all freely attacked as well as cotton. In the main maize areas the serious damage to cotton tends to occur when the commercial maize has ceased tasselling. Any farming measure which helps towards having other crops flowering at the same time as the main cotton crop is in flower alleviates the American Bollworm position.

Sudan or Red Bollworm.—With this pest the caterpillars naturally feed only on wild cotton plants in the veld, or possibly on plants in the veld closely related to cotton (the moths hatch out after the first rains in October, November, December) and it is probable that egg-laying moths travel considerable distances. If there is any stand-over or ratoon cotton being grown, the moths concentrate on such cotton and lay eggs freely, thus producing a large second generation of moths to attack the main cotton crop when it has reached the proper stage of growth. It follows therefore that any leaving of cotton crops stand-over from one season to the next, or any system of ratoon crops, is most harmful to the industry, and on this account the practice is prohibited.

Stainer.—Stainers are plant sucking bugs, reddish in colour, and about ½ to ¾ of an inch in size. They live naturally in the veld on plants related to cotton. Where they are a very serious pest there is little that can be done to ease the damage. In fact, in some areas in this country it is probable that the attack of stainers will be the limiting factor to native cotton growing. In some of these areas where irrigation is available it may be possible to dodge the stainer attack by planting cotton out of season. In most areas, however, where stainers are not normally the limiting factor to cotton growing, crops which are planted early are less liable to attack. As with Sudan Bollworm and system of stand-over or ratoon cropping encourages attack.

In native areas with small gardens under cotton it would probably be quite practicable to destroy the batches of very small young stainers which feed on the first open bolls. This helps to lessen the damage for the second generation.

Aphis.—The plant louse, or aphis, attacks cotton and many other crops during the growing season. From the feeding aphids a sticky honey-dew is deposited on the plants. In a season with drought periods in February-March this is especially noticeable. This, however, is not serious, as it disappears as the season goes on.

Seed Supply.—All enquiries for cotton seed, whether for planting or for cattle feed, should be addressed to:—

The Secretary,
Cotton Research & Industry Board,
P. O. Box 1277,
Salisbury.

It is advisable to order one's seed requirements as early as possible. All cotton seed for planting issued by the Cotton Research and Industry Board is tested for soundness, and every precaution is taken to ensure that only the best seed is sent out.

Conclusion.—For those who contemplate cotton growing, the following points are worth repeating:—

(1) Prepare lands in plenty of time and secure a good even tilth.

(2) Order your seed well in advance.

(3) Plant early.

(4) Use plenty of seed.

(5) Early thinning and cleaning are both essential.

Recent Observations on Fertilizer Placement for Tobacco

By R. J. Haslam and F. A. Stinson, Tobacco Experiment Station, Ontario.

In recent years in both Canada and the United States considerable attention has been focussed on methods of applying commercial fertilisers to various crops, particularly those crops which tend to respond most readily to commercial plant foods and receive liberal applications of them. Naturally, results of experiments in this connection have been highly important from the standpoint of the tobacco crop.

Ordinarily, fertilisers for tobacco are applied in either of two ways, namely, in a localised area, usually termed as "drilling" in the hill or row, and over the surface with a grain drill attachment commonly referred to as "broadcasting." Except in a few specific cases in the Old Belt the former method is used almost universally for flue-cured tobacco, while both methods apply to burley and dark tobacco, with possibly more drilling than broadcasting, particularly for the dark type.

Frequently growers have experienced poor stands of tobacco due to faulty application of commercial fertilisers. In order to furnish growers with more intelligent information in this connection, experiments on fertiliser placement were conducted over a period of years at the Dominion Experimental Station, Harrow, Ontario, and at the Dominion Experimental Substation, Delhi, Ontario. Experiments at Harrow in the Old Belt were applied to the three types of tobacco, namely, flue-cured, burley and dark; while at Delhi all tests were confined to flue-cured tobacco. More recently co-operative tests have been extended to commercial farms in Essex and Kent Counties. Consequently, soil type as well as kind of tobacco was given due consideration when conducting these experiments. The results of these tests, summarised as follows, should be of interest to tobacco growers. In the tests conducted by the Harrow Station soil type was found to be an influencing factor when applying commercial fertiliser to tobacco. Heavy soils demonstrated greater protection against fertiliser burn than light soils, possibly due to the higher organic content of the former soil type. Depth of application was vitally important. Fertilisers applied at a depth of four inches gave better results than shallower placements, particularly for dark tobacco.

Although applying fertiliser with the grain drill attachment gave excellent protection against fertiliser burn, higher yields were obtained with the same quantity of fertiliser applied in two bands, two and one-half inches to each side of the row and one inch below the root crown. Fertiliser applied in the row directly under the tobacco plants a week to ten days before transplanting gave less efficient results than the band method. Fertiliser evidently was most economically utilised when applied in bands at the time of transplanting.

Preliminary experiments at Harrow indicated that yields could be slightly increased and quality of tobacco maintained by splitting the application of fertiliser; for example, by applying two-thirds at time of planting and the remainder two or three weeks later as a side dressing. Soil type and seasonal conditions appeared to influence the relative merit of this method in that respect.

Some different aspects of the problem of fertiliser placement are presented by the results from various methods of application to flue-cured tobacco in the New Belt. Localising the fertiliser in the row before transplanting results in uneven stands owing to fertiliser burn or plasmolysis of the roots. On the other hand, broadcasting appears to delay maturity and reduce yield owing to reduced accessibility of the fertiliser to the root. Results of a number of tests have indicated that the fertiliser should be localised far enough from the roots of the seedling to avoid burning but close enough so the roots will reach it when they begin to grow, at which time the fertiliser has lost its burning properties.

A fertiliser attachment, which places the fertiliser at a definite depth and distance with respect to the row of plant roots, has been used on a tobacco transplanter in a series of comparisons at the Delhi Substation during the past two seasons. In this attempt to determine the most satisfactory position for the fertiliser, the band method of application at time of transplanting by means of a fertiliser attachment on the transplanter has consistently improved the yield and the quality of flue-cured tobacco over the applications made with the regular fertiliser drill in the row either a week before or at the time of transplanting. This attachment and method of distributing fertiliser for tobacco seem to have possibilities, not only as a means of improving the tobacco crop but also as one of eliminating the cost of drilling in advance as well as the danger of leaching during the period between the time of application and of transplanting. Delayed growth and consequent late maturity resulted from placing the fertiliser above the level of the root crown or at a distance of nine inches from the row. Placing the bands of fertiliser closer than four inches from the row presented practical difficulties and appeared to have no advantage over an application placed at a slightly greater distance. It is strongly indicated that the most satisfactory method of applying fertiliser in the average New Belt soil is to place it in bands four to six inches at each side of the tobacco row and an inch below the level of the root crowns, at the time of transplanting.

In conclusion, it is natural to assume that commercial fertilisers will continue to be indispensable in the production of Ontario tobaccos, but their economical usage, including proper method and time of application, is likely to become more and more important in efficient crop production.—(*The Lighter*, April, 1940.)

KUDZU
(Puerania Thunbergiana)

CULTIVATION AND PROPAGATION.

Eastern Asia is the natural home of kudzu. It was first cultivated in Japan, from whence it was introduced to America and other countries. It is a perennial legume which throws out long runners or vines which twine around and over other objects and vegetation. In the absence of supporting vegetation the vines rest on the surface of the soil. Under favourable conditions the main vines reach to over 50 feet in length in a single season and produce many subsidiary vines which cover the land on either side. Roots are formed at the leaf nodes and some of these eventually develop into starchy tuberous "tap-roots" two to six feet long, terminating in thinner growths which penetrate into the subsoil for several feet. (See Plate No. 1.) These characteristics enable the plants to withstand drought to a marked extent, as is shown by the strong growth it makes as soon as warm weather arrives in the spring of the year and before any rain falls. After a thick stand of plants has been formed the growth becomes fine and dense, resembling that of velvet beans and other unsupported climbers. When this stage is reached the crop can be used as fodder for all kinds of livestock and it may be fed either green, as silage or as hay.

The analyses given below, made by the Chemists of the Department of Agriculture, of material grown at this Station, show that kudzu hay is of high feeding value and that it is richer in protein than that of some of our better known hay crops.

	Kudzu	Velvet Bean.	Sunn-hemp.	Soya Bean.	Cowpea.
Moisture......	4.52	9.3	7.66	10.67	10.0
Ash	6.28	7.8	5.11	6.03	7.3
Crude Protein	13.38	13.3	11.42	12.94	10.0
Ether Extract	2.43	2.5	1.01	1.96	1.1
Fibre	34.57	27.6	42.17	25.85	29.6
Carbohydrates	38.82	39.5	32.63	42.55	42.0

In the year 1918 seed of kudzu was sown at the Salisbury Agricultural Experiment Station and some of the resulting plants are still yielding a crop of fodder each year. Six years ago it was decided to issue the "crowns" of this plot to farmers to enable them to establish nursery beds of their own and so records of the weight ot fodder produced since that time have not been kept. A conservative estimate of the yield of the remaining part of the plot may be placed at five tons of green fodder per acre per annum. The cropping ability of this plant may be gauged from the tabulation given below, showing the annual yields of green fodder produced on this kudzu plot since it was laid down some twenty-two years ago.

Season.	Tons per acre.
1920	3
1921	6
1922	7
1923	8.6
1924	7.4
1925	8.7
1926	10.5
1927	11.9
1928	9.0
1929	6.2
1930	8.7
1931	11.5
1932	6.5
1933	6.0
1934	9.1
1935-1940 (estimated)	30.0
	150.1

These returns show that kudzu is capable of yielding heavy crops for several years, and because of this in situations in which the crop thrives, it would seem to be of greater value than annual crops for which the land must be ploughed and seeded each year. It is especially suitable for establishment on hill sides where, owing to the danger of soil erosion, the slope is too great for annual crops. The chief drawback with kudzu is that it does not produce much fodder for the first two or three years, and during that time a certain amount of hand labour is required to "layer" the vines to enable them to form roots at all the leaf nodes and thus make a dense stand all over the area. After this has been accomplished heavy crops of leguminous fodder equal in feeding value to lucerne and other well known legumes may be obtained for the cost of reaping and an occasional weeding. Although cattle need to acquire a taste for the fresh material before they become accustomed to it, they eat it with relish when it is converted into hay or silage. Kudzu fodder cures into hay more readily than that of other legumes such as cowpeas, velvet beans, etc., and in favourable weather the hay is ready for stacking within three to six days after cutting. The leaves of kudzu do not shed so readily during the curing process as those of many other crops. Another characteristic of this plant which adds to its value considerably is its ability to produce large quantities of fresh green fodder of high feeding value very early in the season without the aid of artificial supplies of water. (See Plate No. 2.) This fresh fodder has a special value for feeding to livestock at that period of the year, because natural supplies are then usually very scarce. During the early part of the summer rapid growth is made, even in seasons of low rainfall, but in February the rate of growth decreases, and in order to secure fodder of high feeding value, not too course and fibrous, the crop should be converted into hay or silage during that month. Little growth is made between March and July, but with the advent of warm spring weather, new vines appear and grow with surprising rapidity, even when the soil is dry and high temperatures are the rule.

Plots of kudzu established here have been subjected to grazing treatments with the object of ascertaining whether the crop would be suitable for pasture either in a pure stand or mixed with grasses. In the year 1937 a well established patch of kudzu was divided and one half was grazed with cattle in the spring months until the commencement of the rains, after which the cattle were removed from the plot and the crop was allowed to grow without further defoliation until it was cut for silage in the following March. This treatment was repeated in the years 1938 and 1939, and it has weakened

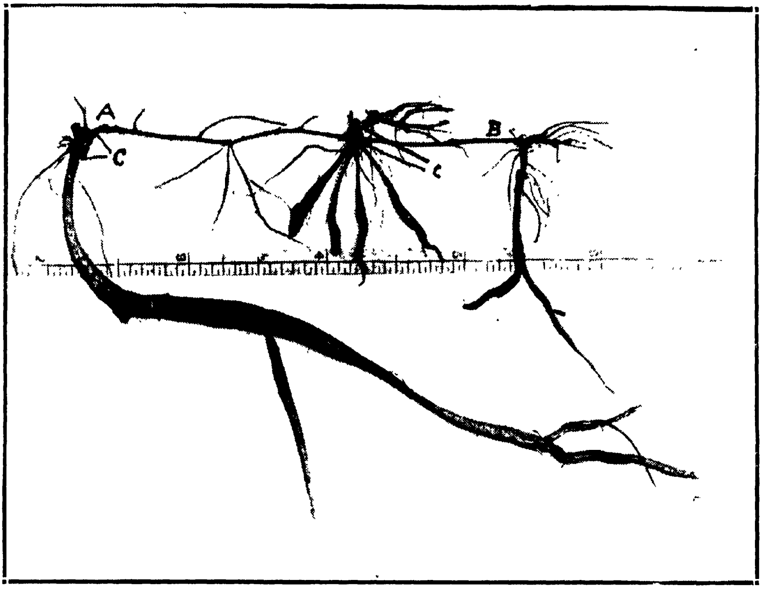


Plate No. 1.—Tuberous root system of kudzu vine, showing large primary crown 5 feet long and secondary crowns attached to vine A B, which was layered to induce propagation

Plate No. 2.—Photograph taken 17th November, 1926, illustrating the luxuriance of the growth made by kudzu before the advent of the rainy season.

the kudzu so much that grasses have now become very strongly established over the whole area. On the part of the plot which has not been grazed, the kudzu is still vigorous. On another area kudzu and Napier fodder were planted together, and over a period of six years the fodder was utilised as silage, which was made in the month of March each year, and the aftermath was grazed off during the winter months. Under this treatment the vigour of the kudzu was satisfactorily maintained. Subsequently this plot was subjected to intermittent summer grazing. After two years both the kudzu and the Napier fodder had become much weakened by this treatment. On a third area kudzu was established eighteen years ago on land which had not previously been ploughed. Holes about 3 feet wide and 3 feet deep were dug at 12 feet apart each way and the crowns were planted therein without disturbing the natural herbage in the intervening spaces. A pound or two of phosphatic fertiliser was incorporated with the soil returned to each hole at the time the crowns were planted. No further applications of fertiliser have been made. Owing to the tendency of the vines to climb over the grass, and hence to loose contact with the soil, some 6 to 8 years elapsed before the spaces between the planting holes were covered with new crowns, but eventually the whole area was over-run and the kudzu has mastered the veld grasses, with the exception of one or two small patches of red-top grass. Each season since the plants became strongly established over this patch, a heavy crop of fodder has been reaped, regardless of whether the season has been a favourable one for other crops or not. There has been no general diminution of vigour among the kudzu plants on this plot, comparable with that on the plots which have been grazed, and it is thought that the reason is because this area has never been grazed. Growth here is allowed to continue unchecked during the spring and summer until the months of February or March, when it is all removed and made into silage.

These experiments indicate that the top-growth should not be removed at short intervals, and it appears that great care should be taken not to over-graze it, as the tramping of the livestock may have a harmful effect on the crowns.

In practice it will probably be found best not to graze at all but to cut the green fodder produced in the spring months and feed it direct to the livestock; and to refrain from grazing or cutting again until the summer crop is ready for making into hay or silage later in the season. When the crop is managed in this way it appears to be able to maintain a vigorous root system capable of withstanding the onslaughts of weeds and unfavourable climatic conditions by building up reserves of food material in its swollen roots and replenishing these as necessity dictates. On the other hand the depletion of the food reserves in the tuberous roots caused by repeated removal of the young shoots results in weakening the root system and surface growth; this allows other plants such as grasses and weeds to become established and competition which is detrimental to the kudzu is the inevitable result.

PROPAGATION.

Kudzu may be propagated from seed and vines, but the surest method of establishing it is by transplanting well developed crowns.

Propagation from "Crowns."—The term "crown" is applied to a stem with its swollen roots. These crowns are somewhat similar to dahlia roots in that the buds are only found on the part located near the surface of the soil, this is joined by a "neck" which has no buds and is about six inches long, to swollen roots which assume the appearance and functions of tubers, excepting that they have no buds from which new growth can be started, and for this reason, during the operation of lifting the crown for transplanting, care must be taken not to injure the upper part or "neck" which joins the swollen part of the root to the stem. Although damage to the swollen root has a weakening effect, it does not prevent growth from taking place if the neck and stem are intact, but if the crown is severed or even severely bruised at the neck, no growth appears from the swollen root, however large and well preserved it may be. In Plate No. 1 the portion marked at "C" is the stem of the plant and the remainder is the root.

The quickest and most reliable method of establishing kudzu is by transplanting crowns which have one or more large tuberous roots. The best crowns are obtained from a field which has been established a number of years, and they should be planted in holes previously opened about 3 feet wide x 2 feet deep. When a large number of crowns are to be planted it is more economical to open trenches with a suitable implement than to dig separate holes for each. The crowns are planted from four to ten feet apart, according to their size. The operation of lifting the crowns for transplanting may be facilitated by first digging a trench two to three feet deep at the edge of the field; then by removing the soil from between the roots with a pointed tool, the tangled mass of tuberous roots can be extricated undamaged with little difficulty. When the crowns are replanted the roots should be spread in a natural manner below ground, leaving about an inch of the stem protruding above the surface. Very few crowns fail to grow if they are carefully lifted and the replanting is followed by favourable weather. The crowns should be protected from the drying effects of sun and air from the time they are lifted until they are replanted, as they lose their vitality if they become dry; but they may be kept in good condition for several days if they are moistened and placed in a sheltered situation.

Propagation from Vines.—If sufficient crowns cannot be obtained, propagation may be effected by "layering" the vines. When the supply is limited and it is desired to accelerate the work of propagation, this may be effected by placing tins of soil close to crowns which have vines four feet long or over. Tins about the size of a half petrol tin are the most suitable for this purpose. They should first be half filled with humus-rich soil and after detaching most of the leaves the young kudzu vines should be wound round on the surface of the soil so that at least two leaf-nodes are in the tin and these must be very firmly covered with soil to prevent the extrication of the vines when they are swayed by the wind. (See Plate No. 3.) Care should be taken to leave eighteen inches or more of the growing tip of the vine uncovered, but if the vine is a long one it may be simultaneously rooted in several tins. The soil in the tins should be kept moist to encourage the formation of roots. This will commence within a few days, but the runners should not be detached from the parent stock until they have become well established and are growing freely. This will require at least a month, but the period will depend on the vitality of the plants and the weather conditions. When it is thought that a strong root system has developed, the parent should be severed, care being exercised during this operation that the young roots are not disturbed. If much new growth has been made, this should be shortened to one or two feet so as not to place undue strain on the newly formed root system. These new plants may then be transplanted to permanent quarters when conditions are favourable, taking care to retain the mass of soil unbroken and so avoid injury to the roots during transplanting. The growth of transplanted rooted plants is at first slow, and it is therefore well when first establishing the crop to put these out into carefully prepared sites.

Propagation by first rooting the vines in tins should only be undertaken when it is desired to propagate quickly from a limited stock. A more economical method is by the use of detached vines which are planted direct in the permanent site. Those which have commenced to form roots are the best, but those which have no roots may be used provided they are well developed. (See Plate No. 4.) The chief drawback to this method is the limited period during which it can be successfully practised, because only vines which are large and well matured will give the desired results. Under dryland conditions the vines are not sufficiently mature until about the middle of January, and they must be planted before the middle of February, in order that the young plants may develop a root system which is strong enough to withstand the long winter drought. Although success depends largely on the weather conditions which prevail during the latter half of the season this method will probably be found to be more convenient and economical than any other when kudzu is being propagated on a large scale. Vigorous vines of the current season's growth are the best for this purpose. Those thinner than a lead pencil should not be used. Commencing at the growing tip, they should be traced back and disentangled from the smaller vines, side growths being removed and reasonable care taken not to bruise or cut the vine until the parent crown is reached. If they have previously formed roots at the basal end, that portion should be taken also; because it will quickly "strike" and assist in the formation of roots along the remainder.

Plate No. 3.—Kudzu vines can be rooted in tins placed near the parent plant. Several new plants can be obtained from each vine by this method.

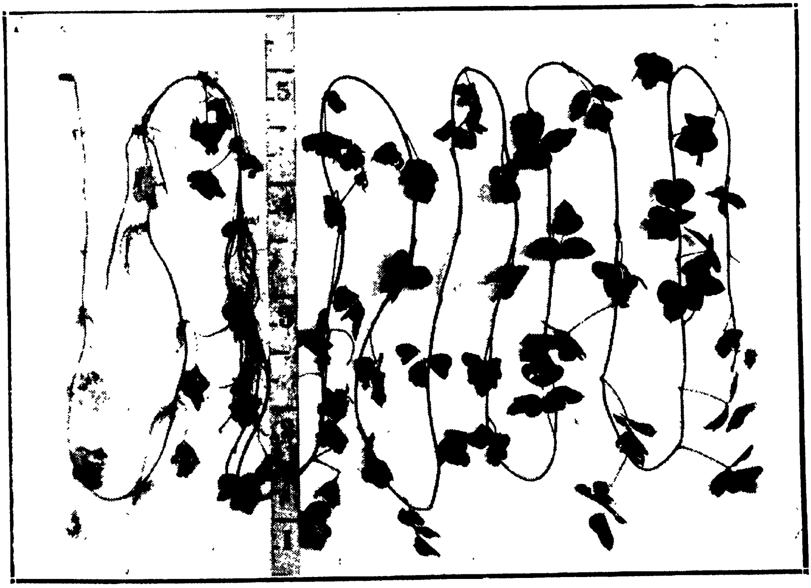


Plate No. 4.—Kudzu vine 40 feet long, one season's growth. The portion on the left was "layered" at the beginning of the season, and has made strong roots at nearly every leaf node. Vigorous vines like this are the best for propagation purposes.

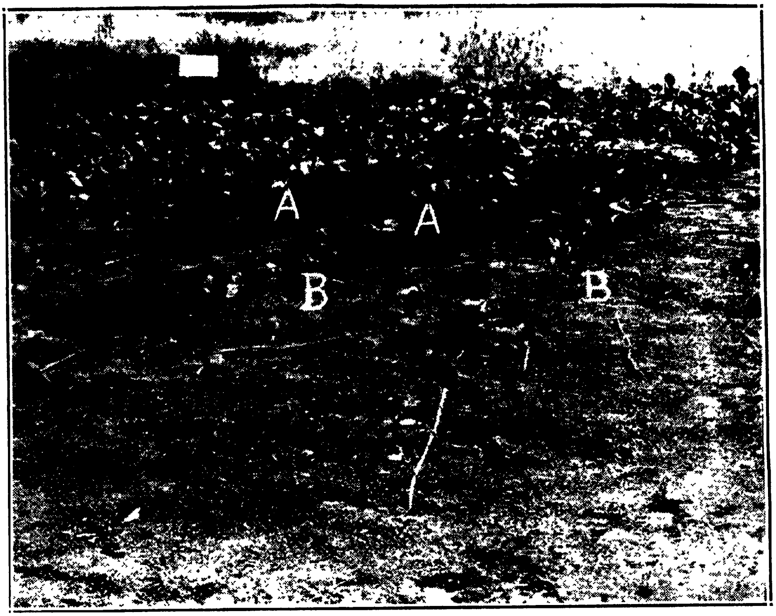


Plate No. 5.—Kudzu, showing manner of layering runners. "A" indicates furrows opened to receive the runners; "B" shows the furrows filled in over the vines, but with leaves left above ground

Plate No. 6.—Kudzu establishment trials. Roots planted February, 1926; photograph taken 14th January, 1927. Maize planted close to kudzu (looking westward). Agricultural Experiment Station, Salisbury.

Plate No. 7.—Kudzu establishment trials. Photograph taken May, 1927. By comparing this illustration with Plate No. 6 the progress of the kudzu may be noted. The kudzu has now become established under the maize crop (looking eastward).

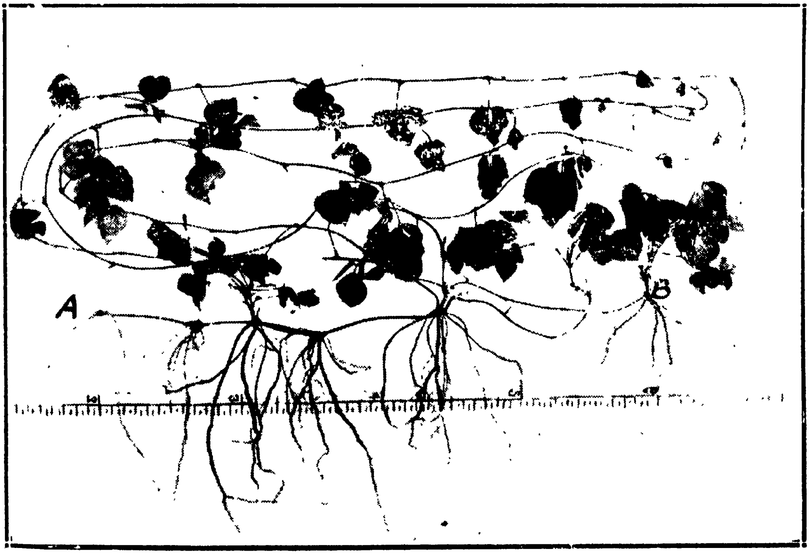


Plate No. 8.—The vine A B was layered in February, 1926, and lifted a year later. The illustration shows the root development and top growth made during that period. Note that the parent vine links the whole root system of the new crowns together to their mutual benefit.

Experiments have shown that better results are obtained from whole vines than from segments and that the basal portion next to the parent crown should be included. The soft growing tip ends for some two to four feet in length as well as immature side growths seldom form roots and may be discarded. In order to reduce the loss of water from the vine all the leaves on the basal part are removed and on the other part three or four leaves are discarded for each one that is allowed to remain. After the "cuttings" have been prepared in the manner described each should be wound into a spool to facilitate subsequent handlings. Unless precautions, such as packing in wet material, are taken to prevent wilting, they should be planted without delay in furrows previously prepared to receive them.

In order to minimise the harmful effects of droughty conditions which may follow the planting of the vines, it is advisable to place a few feet of the tough rope-like basal portion of the vine as deep down as is practicable, so that it will be in contact with moist soil, from which it will absorb the water necessary to maintain the vitality of the younger portions where new growth first appears. It may be mentioned here that among the various methods of propagation investigated at this Station was one in which holes 3 feet by 2½ feet deep were dug and left open until they had become thoroughly soaked with rain water. Then a complete vine was planted in each hole by starting with a few feet of the basal end of the bottom and anchoring it there with an inch or two of soil, after which it was wound round and round in the form of a spiral at the same time as the remainder of the soil was returned to the hole. By this means the vine was embedded in damp soil in the form of a gradually ascending spiral, with the result that it continued to grow without apparent check. Eventually all the vines treated in this way formed very strong crowns. Although this might not be the most economical method for establishing the crop on a large scale it serves to indicate that a better "strike" will be obtained if a few feet of the basal end can be placed in the bottom of furrows which have been made as deep as the plough will enter. The remaining part of the vine should slant upward so that at least one half is not buried more than three to four inches deep.

As the cutting is uncoiled on to the bottom of the furrow, an inch or two of soil is thrown on to it, and is trodden down by the planter who walks in the trench as the planting proceeds. It is important that this soil should be pressed into close contact with the vine so that it is enabled to maintain its vitality by absorbing moisture from the soil until roots have developed. The leaves which were left on should not be covered, and if desired, the part of the runner to which the leaf is attached may protrude above ground, but the portions exposed should not together equal more than about a quarter of the whole length. The furrows should be filled to the top except for a slight depression, which will serve to collect rain water.

If the weather remains favourable for a week or so after planting, some 80 per cent. of the cuttings may be expected to "strike," each producing several young plants, which will appear above ground at intervals after two weeks from the date of planting.

When the plants have become well established their prostrate runners grow in all directions, sending down roots wherever they come in close contact with the ground, and in this way new plants are established of their own accord without special attention being given them. As, however, an even stand in which the whole surface of the ground is covered with rooted plants is more desirable than the patchiness which results if the plants receive no further attention, it is advisable to bury the first runners as they grow two to four inches deep and to within a foot or so of the growing tips. This prevents them from being blown about by the wind, is conducive to the formation of roots and the rapid establishment of new plants at nearly every leaf-node. A liberal application of phosphatic fertiliser in the shallow furrows opened to receive the vines induces rapid rooting, accelerates growth and increases the yields of fodder in subsequent seasons. (See Plate No. 5.)

If the newly formed runners are buried at intervals of two to three weeks during the growing season, they will grow apace, and in this way the original line or plot may be extended to many feet on either side each season. During the exceptionally dry season of 1921-22 many established plants produced vines which grew to over 50 feet in length in six to seven months. It is calculated that each of these with its subsidiary branches will have produced upwards of a hundred new plants in the season.

As it is an easy matter to establish kudzu in the above manner, it is thought that where there is a well established plot to draw on, and where it is desired to grow the crop on a large scale, it will be more satisfactory to first establish single lines of plants at comparatively wide distances apart, and meanwhile to grow other crops between these lines until such time as the kudzu has extended itself over the whole area. (See Plates Nos. 6 and 7.)

Propagation from Seed.—Kudzu seed is expensive, of low germinating power, and growth in the seedling stages is very slow. Sowings *in situ* are not usually satisfactory because the rainfall period is too short to allow of sufficient growth being made to enable the plants to withstand the long rainless winter period. Sowing *in situ* should only be practised when supplies of water are available to supplement the natural precipitation, and even then, owing to their slow initial growth and the consequent necessity for careful and frequent weedings, it is thought that it would be found more economical to first sow in seed beds and transplant later to permanent positions. In such beds the seed should be sown thinly after first ascertaining its germinating power, so that the rate of seeding may be regulated to provide a stand of plants about six inches apart each way. These should remain in the seed beds until their roots are at least as thick as a lead pencil, which may require a period of two years or more. It is preferable to transplant them to their permanent places as early in the season as possible in order that they may become well established before they encounter the rigours of the rainless season.

Owing to the slow development of the kudzu seedlings the work of raising them will be found very tedious, and this method of propagation cannot be recommended except for farmers who are unable to obtain crowns or suitable vines from other sources.

The promising results obtained with kudzu were first made known as long ago as the year 1921, and at various times since, information about the progress of the crop on this Station has been published in this Journal. Numerous issues of crowns have been sent to farmers in every part of the Colony, but apparently only a very few have succeeded in establishing the crop on more than a very small scale. The chief reason for the apparent neglect of this crop is probably because there is no quick and easy method of establishing it, so that interest in it must be sustained for two or three years before much reward can be obtained for the expenditure incurred. Although this is a disadvantage, the yields of fodder obtained here indicate that the initial expense would be well justified in the case of dairymen and others who can make use of high quality leguminous fodder, and that large supplies of this would be available without fail for several seasons at a cost much lower than that incurred in the growing of annual crops.

A few farmers have reported that their stands were depleted through termite attack, and the result of enquiries show that while certain species attack the kudzu others do not; in fact, luxuriant kudzu plants may be found growing on a termite mound at this Station. Experience gained here indicates that only sites which are well drained are suitable for kudzu. In a few cases where newly planted crowns have been planted in depressions in which storm water has collected and maintained a waterlogged condition for a few weeks, the crowns have died. This indicates that the crop would not tolerate "wet feet," but information on this point is meagre.

There are a limited number of kudzu crowns still available for issue to farmers in this Colony. For terms apply to the Agriculturist, Department of Agriculture, Salisbury.

Annual Report of The Senior Plant Pathologist

FOR THE YEAR ENDING 31st DECEMBER, 1939.

By J. C. F. HOPKINS, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

Staff.—The Professional Assistant was absent on sick leave for two periods of two weeks and six weeks respectively, during which time the typing and office records were executed by Miss T. Short and Miss M. Chatterton.

Miss J. Clarke assisted with the mycological herbarium and in the laboratory for a period of three months.

Movements.—One hundred and seventeen visits have been paid to farms in the following districts:—Umtali, Chipinga, Melsetter, Marandellas, Rusapi, Inyanga, Norton, Mazoe, Umvukwes, Lomagundi and Salisbury.

Eighteen inspections have been made of fruit and vegetables and tobacco in the Warehouse, while observation has been kept on nurseries and plants in quarantine and in public gardens at Bulawayo, Salisbury and Umtali.

A visit was paid to the Municipal tobacco experimental plot at Bulawayo.

The Senior Plant Pathologist attended the Agricultural Shows at Bindura, Salisbury and Umtali to judge maize and produce.

LABORATORY.

General.—The amount of material received for laboratory examination has increased considerably during the year. Four hundred and thirty-six lots were dealt with. This is forty-three in excess of that received in 1938, which was again very much greater than that received in any previous year.

It is becoming increasingly difficult to cope with the demands that are being made by the public for advice on plant disease control, and during the past year it has again been necessary to abandon various lines of investigation which have been carried on for several years, whilst numerous requests for visits to farms and districts have had to be refused.

Thirty-six diseases new to the Colony were recorded, of which the following are the most important:—

Sclerotium rolfsii on apricot roots; *Verticillium ?agaricinum* causing mouldiness of cultivated mushrooms (*Pholiota* sp.); *Sphacelotheca andropogonis*, smut of *Andropogon gayanus*; *Cerebella Cenchroidis* on *Cenchrus ciliaris*; *Ustilago trichophora* on *Echinochloa pyramidalis*; bitter pit of quince fruits; *Armillaria mellea* on roots of loquat, peach and orange; *Phomopsis* (probably *Diaporthe phaseolarum*) on tomato fruit; Mosaic of cassava; *Fusarium scirpi* var. *filiferum* in cotton bolls; *Cystopus bliti* f. *achyranthis* on *Achyranthus* sp.; *Puccinia pruni-spinosae*, rust of nectarines; *Hexagona pobeguini*, apparently parasitic on branches of *Brachystegia randii; Plectodiscella veneta* on loganberry stems and leaves; *Fusarium bulbigenum* var. *lycopersici* on carnation roots; "Mosaic" disease of pawpaw; *Nematospora coryli* in sunnhemp seed; *Rhizoctonia solani* on onion seedlings; *Colletotrichum graminicolum* on maize stalks; "Kromnek" virus in dahlias; *Phyllosticta solitaria* on apple leaf.

Other new records for the Colony, supplied by Dr. G. R Bates, of the Citrus Experimental Station, Mazoe, are:—

Stachylidium theobromae and *Glomerella cingulata* on banana fruits; *Aspergillus niger, Fusarium moniliforme, Trichoderma viride, Phytophthora citrophthora, Phomopsis citri, Penicillium digitatum* on lemon fruits; *P. digitatum* and *P. italicum* on grapefruit fruits; *Trichoderma viride* on branches of grapefruit and orange and on roots of orange; *Pleospora herbarum* on orange fruits.

In addition, a large number of specimens have remained undetermined owing to inadequacy of staff to deal with them, despite assistance rendered by the Imperial Mycological Institute and the Department of Agriculture, Pretoria.

A certain amount of accumulated undetermined material was named and placed in the herbarium during the three months that Miss Clarke was engaged. Since her departure, however, it has not been found possible to continue with herbarium work so that an increasing time lag is occurring in the records and reference indexes.

A wide range of plant diseases has been submitted for report. There is no doubt that members of the public are realising more and more each year the service which is afforded by this branch. No longer is advice sought by farmers alone, but a large number of people who rely on flower, fruit and vegetable culture for an appreciable portion of their income are seeking assistance. Unfortunately the diseases submitted by them are often difficult to diagnose and call for a good deal of cultural work. Although every effort is made to cope with the public demands, yet time does not allow of the more obscure diseases to be fully determined. If this clinical work continues to expand at the same rate as in the last two years, it may be necessary to consider making a charge for certain kinds of work and employing sufficient staff to deal adequately with it.

On the outbreak of war the policy of this laboratory was changed. Some lines of investigation which had been commenced earlier in the year were abandoned and more attention was given to increasing crop production by propaganda on disease control, utilising the information at present available.

Examination of Seed.—Examination of maize seed exhibited for sale was commenced, following observations made at the Agricultural Shows, which indicated a high percentage of visible infection by fungi. The first dozen samples showed infection by seed-borne fungi ranging from 100 per cent. to 37 per cent. A great deal of this was caused by *Fusarium moniliforme*, but *Giberella fugikuroi* and *G. saubinetii* and *Diplodia zeae* were also present in abnormally high proportion. Continued examination of seed samples produced similar results, but one sample showed only 4 per cent. infection on germination. It was ascertained, however, that this seed had been treated by the grower with a proprietary mercurial dust. All farm-selected seed contained not less than 35 per cent. of grain infected by serious cob-rotting fungi; the only samples showing a lower percentage were those received from the Plant Breeder. These varied from 8 to 15 per cent. of serious disease-producing fungi.

The conclusion to be drawn from the above is that little or no attempt was made by seed producers last season to select cobs free from disease. If such methods are continued, serious deterioration of the maize seed in the Colony is bound to occur.

A pathological analysis of sunnhemp seed was also made following the observed prevalence of discoloured and misshapen seeds exhibited at the Agricultural Shows. This was augmented by an examination of material supplied by the Chief Entomologist.

Discoloured seeds were surface sterilised, cut in half and plated on culture media. Within a few days the fungus *Nematospora coryli* had grown from nearly all inocula. This fungus has been reported previously in Rhodesia only from internally rotted cotton bolls. Germination tests of commercial and specially selected sunnhemp seed indicated that infection was very high. From seed sown in pots, the plants which survived varied from 42 to 59 per cent. When seed was treated with mercurial dusts and sown in beds, no significant increase in the number of plants over the controls was obtained. The percentage survival varied between 49 and 59.

Material supplied by the Chief Entomologist indicated that infection of seed by *N. coryli* followed the puncture of partially developed pods by the Lygaeid bug *Aspilocoryphus fasciativentris* Stäl.

Lodging of Maize.—Further joint work with the Entomological Branch concerned serious losses in maize reported from Fort Victoria and attributed by the growers to depredations of white grubs. These insects proved to be active, but a large sample of roots and cut stalks sent to this Laboratory by the Entomologist proved to be badly infected by Pink cob rot fungus, *Gibrella saubinetii.* The pith, crown roots and anchor roots were in many instances rotted and there is little doubt that much of the lodging of the maize was caused by the fungus.

The exact role played by each of the parasites in the destruction of maize roots is not certain, but there is evidently need for maize growers in Fort Victoria to give serious attention to the control of the "Diplodia" type of disease.

Potatoes.—Wilt diseases of potatoes have been more prevalent than in other years and complaints have been received that the quality of imported "seed" is deteriorating. Examination of tubers showed that the wilting was principally due to *Fusarium* spp., but some serious damage was caused by the black scurf disease due to *Rhizoctonia solani*. The unusual prevalence of these diseases is probably accounted for by the abnormally high rainfall in the early part of the year.

Numerous examinations were made of imported Up-to-date tubers and a rather large amount of powdery scab (*Spongospora subterranea*) was found to be present. Most consignments contained a small percentage of tubers affected by common scab (*Actinomyces scabies*). Samples of diseased and healthy "seed" were planted in plots at the laboratory to test the survival of the two scabs. No case of either appeared on the crop grown from diseased "seed." It is unlikely that powdery scab survives in Rhodesian soils, whilst common scab is of no importance in fertile soils suitable for potato production.

No time could be found for an analysis of virus (degeneration) diseases in imported Scotch "seed," but tubers from a crop of imported English "seed" were grown at the Laboratory. All plants from this plot showed virus symptoms and 25 per cent. developed secondary symptoms of leaf-drop streak and produced only a few small tubers. The grower who supplied the "seed" for test had been using the same strain for several years and had attributed his low yields to early blight (*Alternaria solani*) infection, a disease with which secondary virus symptoms are often confused.

Inspections in the field were also made of crops grown from reputed "second-from-imported" obtained from the Union. A very high percentage of advanced degeneration was observed and it is likely that not more than one-third of a normal crop will be harvested.

Samples of the Hindenburg variety imported from Poland before the war commenced were sent to the Laboratory for report. The general quality of the tubers was good and the cooking quality excellent, but about 20 per cent. were pear-shaped or developing pointed ends. These tubers appear to be affected by the spindle-tuber virus, which is considered in Britain to be a serious degeneration disease and the advisability of distributing such seed in the Colony is questionable.

Fruit.—Further examples of presumed "little leaf" disease on peaches, plums, apples and grapes were submitted for report, and zinc sulphate treatment is being tested. The symptoms tallied with those described by many authors, but certain diagnosis cannot be made until the results of treatment with zinc sulphate are known.

A large proportion of the apple crop was seriously damaged by fruit-cracking (especially the Ohinemuri variety). As this does not appear to be attributable solely to the fungus *Coniothecium chomatosporum*, tests were made with various plant sucking bugs to ascertain if they could initiate the trouble. None of the insects tested gave positive results.

A disease of pawpaw trees apparently identical with that described from Trinidad under the name of "mosaic" appeared in the Laboratory plot towards the end of the dry season, in September. Leaves showed mosaic mottling and later commenced to shrivel, the lower ones being shed. Eventually the crown was affected and one tree died. The control method of cutting off the crown to force side branches was tried and by the end of the year all of the trees except one had apparently recovered and were making normal growth. One tree was untreated but was watered liberally until the rains commenced. This tree also recovered and was producing normal fruit by the end of December. There is no other record of this disease in Rhodesia.

Vegetables and Flowers.—A disease resembling slimy heart of lettuce was very prevalent during the continuous rains in February and was mainly responsible for a shortage of this vegetable in the towns. Several organisms, including a bacterium which is thought to be pathogenic, were isolated, but the disease could not be investigated experimentally. The bacterium isolated did not correspond in its reactions with any of those described from lettuce head rot.

Heavy losses in collections of Rhodesian succulents being grown in Bulawayo occurred during the wet weather. Material was examined in the Laboratory and some organisms isolated, but pressure of work prevented an investigation being undertaken. No control was obtained by applying copper fungicides to the soil round infected plants.

Carnation foot and stem rots were prevalent during the year and considerable financial losses among flower producers were occasioned. Generally speaking affected plants were old and had been grown for several years in the same soil. Improved cultural practices appeared to be necessary in most cases to eliminate the diseases.

Dahlias affected by the "Kromnek" virus were found late in the year. One case only of this disease had been previously reported from Bulawayo. "Kromnek" is transmissible to tobacco and can seriously affect tomatoes and is capable of being spread through the Colony on dahlia tubers. The question of eradication is being dealt with.

Gladiolus rust was found on an unidentified indigenous species.

Tobacco.—A large number of cases of wildfire were received early in the present season and rosette was reported on certain weeds and veld plants. *Solanum panduriforme*, *Amaranthus* sp. and an unidentified plant apparently belonging to the Labiatae, growing in the proximity of seed-beds infected with rosette, were found by the Entomologist to be infected with green aphids. Attempts were made to produce the rosette disease in tobacco by means of aphids taken from the wild plants pending the identification of the insect. No positive results have so far been obtained.

Miscellaneous.—Assistance was given to the Government Analyst in the examination of human stomach contents, to Dr. Bates of the Citrus Experimental Station, Mazoe, in the identification of bacteria isolated from citrus fruits in storage, and to the Government Archivist in the control of moulds which developed on the books and papers in his charge.

An investigation into the formation of mycorrhiza by cotton plants grown on composted and uncomposted soil was commenced at the request of the Cotton Specialist, but had to be discontinued owing to increased pressure of work occasioned by the war.

RESEARCH.

As stated above, the increased amount of routine work in the Laboratory has made it necessary to abandon nearly all research projects. Investigations on the degeneration diseases of strawberries have, however, continued and attempts have been made to improve local stocks by the importation of Royal Sovereign clones from England. The plants grew well at the Laboratory and produced large, full flavoured fruit, but all developed symptoms of mild or severe crinkle as soon as fruiting commenced. Those affected by severe crinkle were rogued out and discarded and the remainder were sending out runners by the end of the year. There will be sufficient clones for trial in other parts of the Colony next year.

It is now almost certain that one vector of the viruses is the strawberry aphis, *Capitophorus fragariae* Theo., but confirmation is dependent on the production of virus-free plants for transmission experiments.

Selection of peas resistant to mildew has continued and sufficient seed of 18 selections has been obtained for trial on a commercial scale. Seeds were sown with the first rains.

Maize.—The full report on the investigations into seed-borne diseases of maize carried out at Pretoria University was received during the year.

CROPS.

Tobacco.—An unusually large number of reports have been received of wildfire in this season's seed-beds and lands. The disease has appeared in all tobacco growing districts and in many cases on new farms. So far only a few cases of serious damage have been reported, but the disease is always potentially dangerous and is likely to continue to develop if a spell of dry weather does not occur.

The continual rains in December coupled with the severe outbreak of wildfire have resulted in field spraying being adopted by a large number of growers. So great has been the demand for knapsack pumps that, despite increased stocks held by merchants, the entire supply of the Colony was exhausted before Christmas. The stocks of fungicides have had to be constantly replenished from the Union, but, except for a proprietary brand of colloidal copper, the dispatch of which from the United Kingdom was held up by the war, no serious shortage has occurred.

Why wildfire should have been so widespread is difficult to explain. That more severe outbreaks than usual should have occurred was only to be expected during the abnormally heavy early rains, but the sudden appearance of a few diseased plants in one corner of a land, of an infected patch not more than three yards long in one seed-bed only out of several hundred on one farm, or the occurrence of general infection in all plantings on a new farm, where tobacco has never been grown and which is situated 20 miles from the nearest growing tobacco, is not explicable on the grounds of natural spread.

Seed was suspected to be the agent of distribution, but extensive enquiries ruled out this as a general explanation. All the usual sources of infection were examined without any satisfactory solution being found, and suspicion now rests on natives' tobacco. Arrangements are being made to investigate this possibility.

Last season brown spot (*Alternaria longipes*) caused very heavy losses in nearly all parts of the Colony. The disease was in large measure responsible for the short weight and light texture of the crop, because it destroyed most of the full bodied leaf. Many growers who had not experienced the disease in previous years lost the top three or four leaves of their entire crop, whilst others of more experience only saved their plants by allowing "suckers" to grow unchecked, thus reducing the body of the leaf.

After such heavy and widespread infection it is to be feared that the disease may become serious in the present season, especially as growers have been urged to produce heavy leaf. In some districts brown spot appeared before the end of the year, but had not become serious.

Rosette appeared in nearly all districts last season, but little damage was reported. Most growers were able to recognise the disease very early and rogued out infected plants. This method of control has so far proved satisfactory. During the present season rosette appeared earlier than usual. presumably as a result of the earlier rains, but it is again being satisfactorily controlled by rogueing.

Spraying with Bordeaux nicotine in seed-beds has proved efficacious in reducing aphis infestation, but field spraying on similar lines has the objection of being costly, slow and uncertain. It has, however, been done successfully by some growers.

In order to popularise field spraying of tobacco, twelve demonstration plots of 10 acres each have been organised in various tobacco districts. This has only been made possible by the much appreciated co-operation of manufacturers and farmers, who have supplied spray material, and labour and supervision respectively, whilst this Branch has supplied knapsack pumps.

Maize.—The maize exhibited at Agricultural Shows this year has in many cases been visibly infected with cob rotting fungi. This fact indicated the presence of a considerable amount of disease in the seed available for the present season. As reported under "Laboratory," germination tests revealed a deplorable state of affairs which can only be explained by general slackness in seed selection combined with last season's heavy rains which caused cob rotting fungi to develop more than usual.

The publicity given in the *Rhodesia Agricultural Journal* and the Press to the quantity of disease in this year's seed led to a greatly increased demand for disinfectant dusts. It was known that ample stocks were available before the publicity campaign was launched, so that despite the exceptional demand, no shortage occurred. There is no doubt that the Colony will be greatly benefited if growers will only reject for seed purposes all cobs showing any discoloured grain, no matter how little, and adopt as a routine practice seed disinfection with mercurial dusts.

Apples.—There was a large amount of decay in apple fruits last season, much resulting from fruit cracking. This is referred to under "Laboratory."

Although some growers are spraying their trees more thoroughly, the majority are not following the complete schedule recommended last year, so that certain diseases, particularly mildew, continue to do damage.

The experimental spraying being carried out at Rusapi has yielded valuable information, and this season the sprayed trees are carrying heavy crops of clean fruit, whilst the unsprayed controls have practically no crop at all.

It is apparent that "little leaf" disease is extremely prevalent on all kinds of deciduous fruit, including vines. A number of growers are applying zinc sulphate to affected trees, and in some cases the response has been immediate.

Potatoes.—Greater interest than has been shown by growers for a long time is evident in the control of potato diseases. Numbers of enquiries regarding spraying against early blight (*Alternaria solani*) have been received and advice has been given on suitable kinds of equipment and fungicides.

Growers still experience difficulty in distinguishing between secondary symptoms of virus degeneration and the leaf spotting caused by the early blight fungus. Reports of failure to control the latter by spraying may be attributed to this cause, and the exposure of the common mistake in diagnosis has drawn growers' attention to the very poor "seed" which many have been planting in recent years. Early dying down of haulms has in the past been attributed almost solely to early blight.

In order to improve the "seed" position, the Manager of the Farmers' Co-op Ltd., Salisbury, was asked to urge upon growers of "seed" potatoes the necessity of importing only the very best grade Scotch tubers available, in view of the possibility of "seed" supply being cut off. As a consequence, a number of cases of N.I.(A) certificated Scotch "seed" has been imported and the Agriculturist has arranged for it to be planted under expert supervision at Inyanga.

For many years the growing of "seed" for the Colony at Inyanga under Departmental control has been advocated by this Branch, because it has been shown that with correct rogueing and storage, the virility of Up-to-date "seed" can be maintained locally for a long period. It now remains to be seen for how many years Southern Rhodesia can supply its own "seed."

LEGISLATION.

Seven meetings of the Plant Regulatory Board were attended.

Matters of plant pathological interest which were dealt with include:—Internal control and certification of potato "seed"; legislation to prevent the introduction of Stewart's disease of maize, and blue mould of tobacco; virus diseases of maize and importation of sugar cane for planting; the presence of the tobacco "Kromnek" virus in dahlias in Southern Rhodesia; the exclusion of *Baccillus vitovorus* in grape vines.

PUBLICATIONS.

The following were published during the year:—

In the *Rhodesia Agricultural Journal.*

1. "Diseases of Tobacco in Southern Rhodesia. Supplement I." January and February issues.
2. "Three Important Strawberry Diseases." April.
3. "Report of the Branch of Plant Pathology for the year ending 31st December, 1938." August.
4. "Mycological Notes 12. The Diplodia Danger." October.
5. "Mycological Notes 13. The Diplodia Danger." November.
6. "Mycological Notes 14. Seasonal Notes on Plant Diseases." December.

In the *Proceedings of the Rhodesia Scientific Association, Vol. xxxvii.*

7. "Recent Advances in Plant Pathology in Southern Rhodesia."

The list of plant diseases occurring in Southern Rhodesia which was first prepared in 1937, has been brought up to date and notes as to the control of the diseases added. It will be published early in 1940 as Memoir No. 2 of the Agricultural Department.

MISCELLANEOUS.

Exhibits were displayed at the Agricultural Shows at Bindura, Salisbury and Umtali. This is the first year that Shows other than at Salisbury have been visited.

A lecture and demonstration were given to teachers attending a vacation course in January and a demonstration to Girl Guides in December. In February an address was delivered to the Bulawayo and District Horticultural Society and a lecture was given to the pupils of the Eveline High School on the same day.

Two museum cabinets have been acquired and a number of specimens suitably prepared for exhibition.

BOTANY.

Largely as a result of demonstrations arranged in the past two years by the Education Department, a greatly increased number of plant specimens have been sent in for determination. Six hundred and twenty lots of material were dealt with by the Professional Assistant, whilst advice was given to schools on the collection and pressing of plants and maintaining herbaria. Following upon the interest now being shown in nature study in the schools, there is every possibility of very greatly increased demands being made on the time of the Professional Assistant.

Numerous germination tests on various types of seed were carried out during the year.

Rhodesia Weather Bureau.

MAY, 1940.

PRECIPITATION.

Station.	Inches.	Normal.	No. of days.
Beitbridge	Nil	0.36	—
Bindura	Nil	0.50	—
Bulawayo	Nil	0.35	—
Chipinga	0.36	1.00	2
Enkeldoorn	Nil	0.32	—
Fort Victoria	Nil	0.33	—
Gwaai Siding	Nil	0.12	—
Gwanda	Nil	0.31	—
Gwelo	Nil	0.30	—
Hartley	Nil	0.26	—
Inyanga	0.01	0.50	1
Marandellas	0.01	0.62	1
Miami	Nil	0.04	—
Mount Darwin	Nil	0.45	—
Mount Nuza	1.13	1.55	5
Mtoko	Nil	0.34	—
New Year's Gift	0.08	0.43	1
Nuanetsi	0.05	0.27	1
Plumtree	Nil	0.69	—
Que Que	Nil	0.24	—
Rusape	Nil	0.35	—
Salisbury	Nil	0.47	—
Shabani	0.09	0.45	1
Sinoia	Nil	0.35	—
Sipolilo	Nil	0.34	—
Stapleford	0.86	1.40	8

Station	Inches.	Normal.	No. of days.
Umtali	0.02	0.51	—
Victoria Falls	Nil	0.42	—
Wankie	Nil	0.32	—
Abercorn	0.55	—	3
Balovale	Nil	—	—
Broken Hill	Nil	—	—
Chinsali	Nil	—	—
Fort Jameson	Nil	—	—
Fort Roseberry	Nil	—	—
Isoka	Nil	—	—
Kalomo	Nil	—	—
Kasama	Nil	—	—
Kasempa	Nil	—	—
Luangwa	Nil	—	—
Livingstone	Nil	—	—
Lundazi	0.14	—	1
Lusaka	Nil	—	—
Mankoya	Nil	—	—
Mazabuka	Nil	—	—
Mkushi	Nil	—	—
Mongu	Nil	—	—
Mpika	Nil	—	—
Mporokoso	1.63	—	2
Mufulira	Nil	—	—
Mumbwa	Nil	—	—
Mwinilungu	Nil	—	—
Namwala	Nil	—	—
Ndola	Nil	—	—
Senanga	Nil	—	—
Sesheke	Nil	—	—
Solwesi	Nil	—	—

MAY, 1940

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F.														PRESSURE MBS.			Cloud Tenths.	Sunshine hours.
		8.30 a.m.							Absolute.		No. of Days.									
		Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min.÷2.	Maximum. Date.	Minimum. Date.	Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hrs.	8.30 a.m. Station Level.	8.30 a.m. 1200 gdm.	Mean of 24 hrs.		
Beitbridge	1486	66.7	57.7	52	9.4	82.7	52.7	67.7	98:1	44:31	9	—	2	—	68.0	968.1	886.6	966.2	2.6	—
Bindura	3700	62.5	56.1	52	6.5	76.1	49.8	62.9	82:v.	43:31	—	—	—	—	—	—	—	—	3.9	—
Bulawayo	4393	60.4	52.2	45	7.7	73.9	48.1	61.0	85:1	37:6	—	8	—	1	60.4	872.3	883.9	871.0	3.3	9.1
Chipinga...	3685	63.1	56.1	51	7.1	71.3	54.6	62.9	85:1	49:6	—	12	1	—	—	895.2	884.5	—	2.9	—
Enkeldoorn...	4808	60.3	52.7	47	7.3	72.6	48.4	60.5	84:1	41:22	—	8	—	—	—	859.8	883.8	—	1.9	—
Fort Victoria	3571	61.4	54.3	48	7.0	75.4	46.6	61.0	88:1	38:29	3	2	—	4	61.2	899.2	884.9	—	2.4	—
Gwanda...	3233	61.2	53.4	47	7.4	76.3	48.2	62.3	90:1	40:31	1	1	—	—	62.3	909.4	884.1	—	2.9	—
Gwelo	4629	59.9	52.2	47	7.1	72.8	48.4	60.6	84:1	39:6	—	6	—	1	59.9	864.9	883.7	—	3.0	—
Hartley	3879	61.4	54.5	49	6.8	76.7	47.2	61.9	85:1	36:6	—	—	—	1	61.3	888.5	884.0	—	1.1	—
Inyanga	5503	61.0	56.1	53	4.9	69.3	45.3	57.3	80:2	38:30	—	14	—	1	—	—	—	—	1.8	—
Marandellas	5453	58.9	53.0	47	5.5	70.1	46.3	58.2	80:1	40:v.	—	15	—	—	—	—	—	—	2.3	—
Miami	4090	63.4	57.1	53	6.5	75.0	49.7	62.5	84:2	45:6	—	2	—	—	60.4	881.0	883.0	879.5	2.1	—
Mt. Darwin...	3179	64.0	60.5	58	3.8	77.6	49.1	63.3	85:1	40:30	—	—	—	—	—	—	—	—	1.6	—
Mount Nuza	6668	51.5	47.3	43	3.5	58.9	46.3	52.6	72:2	41:9	—	29	—	—	51.2	803.6	884.2	—	4.5	—
Mtoko...	4136	62.9	55.7	50	7.3	73.2	53.1	63.1	83:2	47:22	—	5	—	—	62.7	880.3	883.9	879.1	2.4	—
New Year's Gift ...	2690	61.9	56.6	53	5.4	76.9	50.9	63.9	91:1	42:6	2	2	—	—	—	—	—	—	—	8.1
Nuanetsi	1547	65.4	58.3	53	7.6	83.8	47.9	65.9	99:1	40:v.	10	—	—	—	—	966.8	885.8	—	1.6	—
Que Que...	3999	60.7	54.4	49	6.1	76.0	49.3	62.7	86:1	41:6	2	2	—	—	62.1	884.6	883.8	883.1	2.7	—
Rusape	4648	59.8	53.3	48	6.2	71.8	46.1	58.9	83:1	39:v.	—	9	—	3	58.2	—	—	—	1.7	—
Salisbury	4831	60.8	53.7	48	6.8	73.4	47.4	60.4	81:2	40:6	—	5	—	—	60.0	858.8	883.8	857.4	2.6	8.3
Sinoia	3795	61.8	55.6	51	6.2	78.5	45.1	61.8	86:2	39:6	1	—	—	2	—	—	—	—	1.5	—

MAY, 1940 (continued)

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F.														PRESSURE MBS.			Cloud Tenths.	Sunshine hours.
		8.30 a.m.							Absolute.		No. of Days.									
		Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min.÷2.	Maximum Date.	Minimum. Date.	Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hrs.	8.30 a.m. Station Level.	8.30 a.m. 1200 gdm.	Mean of 24 hrs.		
Stapleford	5304	56.1	52.7	50	3.1	65.0	42.5	53.8	78:2	33:31	—	26	—	8	52.1	—	—	—	3.1	—
Umtali	3672	61.7	56.9	53	4.8	74.9	51.5	63.2	87:1	45:31	2	1	—	—	62.2	895.6	884.4	894.4	2.8	8.0
Wankie	2569	61.1	55.3	52	6.7	85.4	55.3	70.3	93:3	50:v.	15	—	—	—	—	930.6	883.7	—	2.0	—
Abercorn	5458	64.6	59.2	55	5.9	78.5	55.1	66.8	81:v.	52:v.	—	—	—	—	64.9	838.9	881.8	—	1.6	—
Broken Hill	3911	63.4	56.3	51	7.3	77.1	49.5	63.3	85:4	44:27	—	—	—	—	62.9	886.7	882.9	—	2.3	—
Fort Jameson... ...	3815	68.4	61.3	57	8.0	78.9	58.1	68.5	86:5	53:26	1	—	—	—	66.9	890.3	883.9	888.8	1.2	—
Fort Roseberry ...	3830	67.1	61.3	58	6.5	79.3	50.6	64.9	84:4	47:9	—	—	—	—	64.2	—	—	—	—	—
Kasama	—	65.3	59.9	56	6.0	78.5	55.2	66.9	83:6	48:26	—	—	—	—	66.6	865.3	882.3	864.4	1.3	9.6
Kasempa...	4500	56.2	54.2	53	1.8	78.1	45.5	61.8	83:4	38.28	—	—	—	1	—	—	—	—	—	—
Livingstone...	3051	61.3	55.8	52	5.4	80.2	48.9	64.6	90:1	45:6	5	—	—	—	64.4	911.0	883.0	903.4	2.3	10.0
Luangwa Bridge ...	1330	65.6	60.3	57	5.9	86.7	57.7	72.2	93:v.	53:31	15	—	—	—	71.5	—	—	—	—	—
Lundazi	3590	66.0	61.9	59	4.6	80.2	59.6	64.9	85:v.	43:27	—	—	—	—	63.9	—	—	—	—	—
Lusaka	4193	63.4	56.1	50	7.3	75.0	52.4	63.7	81:3	48:26	—	—	—	—	62.1	877.4	882.7	876.1	3.0	9.2
Mongu	3481	65.4	56.5	50	9.0	80.5	55.1	67.8	88:3	42:6	5	1	—	—	67.5	899.4	882.1	897.8	0.7	10.5
Mpika	4620	65.1	59.4	56	6.2	74.6	54.3	64.4	81:2	50:10	—	3	—	—	62.9	864.5	883.5	—	2.9	—
Msoro	3000	67.2	61.9	59	6.1	85.6	54.6	70.1	91:v.	49:v	16	—	—	—	68.7	—	—	—	—	—
Mumbwa...	3500	57.9	54.2	52	3.5	78.3	43.9	61.1	85:26	39:6	—	—	—	1	60.4	—	—	—	—	—
Mwinilunga...	4450	60.2	57.2	55	3.0	80.9	48.8	64.9	83:v.	44:v.	—	—	—	—	—	—	—	—	—	—
Ndola	4190	61.7	56.6	53	5.2	79.4	50.1	64.7	85:5	44:26	—	—	—	—	64.4	877.6	882.6	875.3	1.2	9.5
Chileka	2600	69.2	62.3	58	7.8	77.4	58.9	68.1	86:3	53:27	1	—	1	—	67.8	—	—	—	3.8	—

Southern Rhodesia Veterinary Report.

MAY, 1940.

DISEASES.

African Coast Fever was discovered on farm Dorasdale in the Charter native district.

TUBERCULIN TEST.

Eleven bulls and one hundred and thirty-one cows were tested on importation, two reactors were destroyed, and nine others are being held over for a further test. A herd of 170 cows on Leachdale farm, Insiza district, were tested, of which 16 head will be re-tested at a later date.

MALLEIN TEST.

Ten horses were tested with negative results.

IMPORTATIONS.

From Union of South Africa: Bulls 7, cows 131, horses 10, sheep 458.

From Bechuanaland Protectorate: Slaughter cattle 930, sheep 437, goats 64.

EXPORTATIONS.

To Northern Rhodesia: Sheep 188.

To Portuguese East Africa: Bulls 6, cows and calves 269, slaughter cattle 108, trek oxen 30, sheep 42, goats 10.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

To United Kingdom: Beef quarters (chilled quality), 11,728; boneless beef quarters, 2,311; tongues, 21,046 lbs.;

livers, 39,132 lbs.; hearts, 13,230 lbs.; tails, 9,901 lbs.; skirts, 7,386 lbs.; shanks, 5,199 lbs.; cheeks, 6,160 lbs.; fillets, 1,146 lbs.

To Northern Rhodesia: Beef carcases, 35; offal, 3,209 lbs.

To Belgian Congo: Beef carcases, 52; mutton carcases, 6; offal, 135 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa: Corned beef, 394,348 lbs.; beef fat, 13,300 lbs.; beef paste, 6,932 lbs.; tongues, 30 lbs.; sausages, 13,620 lbs.

B. A. Myhill,
Chief Veterinary Surgeon.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than stamps.

A 10/- note will cover the subscription for two years.

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All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

Date..194......

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THE RHODESIA
Agricultural Journal

Vol. XXXVII.] No. 8 [August, 1940

Editorial

Notes and Comments

The War and the Land.

In this war more than in any war in history men's minds have turned to what will happen when peace is restored. Governments have declared as part of their war aims their intentions for the eventual peace, and the Allies during the first six or seven months discussed the possibilities of a new post-war European order. It might be said, and perhaps with justice, that had France given more attention to the present and to her own internal state, she would not have been caught so unprepared, but the point to be stressed is, that the actual war, terrible as it is, does not dominate the responsible mind to the exclusion of all else. To the generation that endures it war is momentous; in the whole sweep of history it is an incident. But it is an incident which may have long drawn-out effects. It is inevitable that some of the staggering cost of armaments and defence, with the shrinkage of normal trade, will become a liability to later generations. It is inevitable and all Governments prepare for it. The Economic Advisory Committee which has been set up in England will undoubtedly consider the plan for paying for the war devised by Mr. J. M. Keynes, who is a member of the Committee. The general basis of his plan is compulsory loans in the form of deferred pay. So far this country has had no occasion to appoint Economic Committees, or to worry unduly about the cost of its contribution. But if the war goes on for some years the strain will become great and the monetary drain considerable. In the times that lie ahead it is absolutely essential that our greatest capital asset, which once destroyed, can never be restored, should not be ruined for later generations. The land must be preserved, nourished and guarded.

With the continual use of man-power which will affect the primary producer, and the military training for farmers which is about to begin, the supervision of Europeans will be spread over larger and larger areas. In addition, production will almost certainly be intensified. Elsewhere in this issue is a note on the formation of a Fertiliser Advisory Committee. While stocks of artificial fertiliser are adequate for the coming season there is a danger that the needs of war and the costs and risks of shipment will affect future supplies. The combination of all these circumstances will, unless great care is exercised, seriously and permanently affect the soil. It is vital both for this war and for the future of Rhodesia that the soil should be kept productive, that it should be fed and that it should not be allowed to start on the easy road to ruin.

The making of compost is not affected by the alarms of war, and there is much that is now wasted on the farm that could go to compost. Green-manuring refreshes and enriches the soil, and lime, which is obtainable in quantity in Rhodesia, is unrivalled in its ability to maintain the chemical and phyisical qualities of the soil. Soil conservation too and measures against plant diseases are forms of investment which cannot be too strongly urged.

All these are aids, but in the last resort the vital necessity of safeguarding the land rests with the farmer. It demands his utmost supervision, energy and sacrifice.

Retirement of Charles Kimberlin Brain, M.A., D.Sc., Director of Agriculture.

With the publication of the July issue, Dr. C. K. Brain severed his connection with the *Rhodesia Agricultural Journal*. On the 28th of this month Dr. Brain proceeds on leave pending retirement after a period of 11 years spent in the agricultural service of the Colony. In June, 1929, at the invitation of the then Minister of Agriculture and Lands, the Hon. R. A. Fletcher, Dr. Brain relinquished his posts of

Professor of Entomology at Stellenbosch University and Principal of the Stellenbosch-Elsenberg College of Agriculture, to take up the appointment of Acting Secretary, Department of Agriculture, Southern Rhodesia. During the financial depression a closer welding of the agricultural, land settlement and veterinary services within the Ministerial Division was introduced. The late Mr. A. C. Bagshawe, C.M.G., was appointed Secretarial Head of the Division, and Dr. Brain accepted the post of Director of Agriculture, with which was combined that of Editor of the *Rhodesia Agricultural Journal.* The appointment in the first instance was for a period of five years, and was subsequently extended until such time as Dr. Brain should reach the retiring age.

For the past seven years, in addition to his many other duties, Dr. Brain has been responsible for the major part of the botanical work undertaken by the Department. His interests at first lay primarily with the grasses and sedges, but subsequently he turned his attention to the flora of the Colony as a whole, with the result that he has now completed the first volume of the first Flora of Southern Rhodesia, which it is hoped will appear in print at an early date. The second volume is well advanced and is likely to be completed within the next year. This publication will be of the greatest interest and value to students of botany and all others interested in the flora and pastoral conditions of the Colony.

During his period of service Dr. Brain has travelled widely and has made many friends amongst the farming community, particularly in Mashonaland. Since their inception, he has been Chairman of the Chilimanzi European Settlement Committee, the Southern Rhodesia Tobacco Research Board, the Southern Rhodesia Immigration Committee set up in conjunction with the 1820 Memorial Settlers Committee of the Union of South Africa, and of the Departmental Committees set up to investigate the possibilities of the introduction of New Crops of Economic Importance and to co-ordinate Pasture Research. He has also been a member of the Native Land Board.

In all his associations, Dr. Brain has proved himself a loyal and helpful colleague and his wide but intensive academic training has rendered his advice in connection with various agricultural investigations undertaken by the Department of particular value to his fellow-professional and technical officers. The field and laboratory have always been Dr. Brain's happy hunting grounds, and it is a source of satisfaction to his colleagues to know that there is every prospect of his remaining in the Colony and undertaking on behalf of the Rhodesia Tobacco Association and the Tobacco Research Board investigations which are considered to be of primary importance to the tobacco industry.

On his retirement Dr. Brain will carry with him the warm wishes of his colleagues in the Civil Service, and of his friends in the farming community for many more years of useful life and a full measure of happiness for his family and himself.

Trees on New Contour Ridges.

A local farmer, establishing an orchard on unbroken grass, has encountered and overcome a minor difficulty. A year ago the contour ridges were so spaced and made that by "hillside" ploughing, they will eventually become terraces. As soon as sufficient area has been planted the terracing will be carried out as illustrated in Fig. 5 of Bulletin No. 1148, "Contour Planting and Terracing of Orchards." The difficulty of planting the trees in the loose earth of the newly made ridge was overcome by breaking down the ridge at each tree site and rebuilding it in layers, each layer being consolidated rather in the manner of a tobacco seed-bed. It was then a simple matter to plant the trees near the top of the lower slope of the ridge: a slight depression was left to hold water and a mulch of grass was put round each tree. The time and labour spent in making the ridges was less than that required to give the land even one ploughing.

The strips between have now been broken and planted, and the crop will cover the cost of the gradual terracing which is accomplished by one or two ploughings each year with a reversible plough. The farmer has thus, with limited resources, been able to plant many more trees than by any other method, and at the same time has ensured that all soil and as much water as he thinks fit, are conserved.

Food.

In Great Britain an Advisory Committee to consider national food requirements and home food production has been appointed to assist the War-time Ministry of Food. which has developed from the nucleus of the pre-war Food (Defence Plans) Department. The committee is composed of the President and four distinguished fellows of the Royal Society, together with other agricultural, economic and busines experts. It will bring expert and practical knowledge to the service of the country and will determine agricultural policy. It will deal with food control, nutrition and imports, and its findings will not be without their effect on the Colonies and Dominions. Britain's war-time agricultural policy is, at the moment, based on a programme of ploughing up grass land, to reduce her dependence on imported supplies of foods for both man and animal. But grass land, more particularly since the restrictions on imported feeding stuffs, is vital for animal husbandry. The balance between the two demands and the better utilisation of existing pasture are two of the problems which the committee will solve.

Banana Trees and Nutrition of Stock.

The annual report of the Department of Veterinary Science and Animal Husbandry of Tanganyika Territory for 1938 contains the findings of an investigation on the nutritive value in Tanganyika of chopped bananas. The findings of the investigator, M. H. French, are as follows:—

"Chopped banana plants form a highly digestible food which should be given a wider use. The plants have a low digestible protein content, but their energy producing value is greater than that of mature grasses, grass silage, hay or maize silage. It contains a high percentage of soluble ash and its water content reaches to over ninety per cent. Its succulence and vitamin contents make it a useful food in the dry season, because it reduces considerably the water requirements of the stock, and the animals getting this banana chop along with other dry foods do better, carry a better bloom, and make greater liveweight gains than other animals receiving only the dry fodder."

Fertiliser Advisory Committee.

The Minister of Agriculture and Lands has appointed the following Fertiliser Committee: Mr. A. D. Husband, Chief Chemist (Chairman), Messrs. H. F. Ellis, N. A. Philip, J. Brown, and Captain R. D. James.

The Committee will advise as to the manner which can best be adopted to provide for the Colony's requirements of artificial fertilisers during war-time and the form in which such supplies should be made available to agricultural producers. Apart from future supplies of fertilisers which are liable to become scarcer as the war proceeds, the Committee will investigate the best use to be made of available stocks. The Committee has under consideration the elimination of many of the different mixtures on the market for flue-cured tobacco and their replacement by one or more standardised mixtures in which the percentage of phosphoric oxide will be lower than formerly.

Retirement of Mr. F. B. Brooks.

Mr. F. B. Brooks left the Service on leave on the 21st May, 1940, pending his retirement on the 10th September.

Mr. Brooks joined the Service in 1907 and was appointed to the Law Department. He subsequently transferred to the Accounting Office, B.S.A. Company, which office was in Bulawayo, and was known as the Commercial Representative Office.

In 1912 Mr. Brooks was transferred to Salisbury to the Lands Department, Accounting Office, and was appointed Under Secretary, Department of Lands, on the 1st April, 1934, which position he held until his retirement.

Major E. E. Burt, E.D., has succeeded Mr. Brooks as Under Secretary, Department of Lands, and Chairman of the Farmers' Debt Adjustment Board.

Major Burt joined the British South Africa Police in 1910 and was seconded to the Civil Service on the 1st December, 1911, and subsequently received an appointment in the Department of Agriculture on the 1st February, 1912, and has served since that date in that Department.

During the Great War Major Burt served with the 1st Rhodesia Regiment in German South West Africa. On disbandment of this regiment he proceeded overseas, and with the Royal Field Artillery saw service in France, Flanders, Egypt and Palestine. He was awarded the Efficiency Decoration in 1934.

Major Burt in 1926 was appointed as Secretary of the Agricultural Loans Committee which controlled the distribution of Government funds to farmers in necessitous circumstances.

In 1929, after the slump in maize prices, this officer was appointed as Secretary of the Maize Loan Committee which undertook the distribution of assistance to maize growers to tide them over the period during which the price of maize had shown an appreciable drop.

During 1932 he was seconded to the Land and Agricultural Bank for a period of six months when the Agricultural Loans Scheme was transferred to that institution from Government control.

In 1933 Major Burt was appointed Chief Clerk, Department of Agriculture and Lands, which post he has held until his appointment to the posts referred to above.

Tobacco Seeds.

Farmers are reminded that arrangements have again been made for seeds to be cleaned and treated in the Chemical Laboratories. No extra staff is being engaged for this purpose and it is therefore essential that seeds should be sent in as early as possible. Seeds will not be cleaned cr treated by the Department after the 30th September.

"LACK OF SUCCESS IS LARGELY THE RESULT OF NEGLECTED OPPORTUNITIES."

Opportunities for agricultural cleanliness are always at hand.

Cleanliness Aids Insect Control.

Of Interest to Gardeners

Below we publish a letter despatched by the Branch of Plant Pathology in reply to enquiries received from a resident of Salisbury. The subject matter is typical of the information service made available to the public by the Department of Agriculture:—

Dear Sir,

DISEASED GARDEN PLANTS.

Reference my visit to you at the beginning of the week.

The disease on your mangoes is withertip. This is due to a fungus which attacks young shoots causing them to wither. It affects leaves, producing small angular brown spots and, later, scorching. The disease also produces a soft black rot of the fruit. The trouble is only severe in wet seasons.

Control may be obtained by pruning off diseased shoots and collecting all diseased fruit, which may have shrivelled and remained attached to the tree, as well as fallen fruit lying on the ground. All such rubbish should be burned.

The trees should then be sprayed with Bordeaux mixture at summer strength, according to manufacturers' directions. Further spraying should be given in August, September and October, taking care to cover the terminal leaves and young fruits.

Your apples, peaches and plums are affected by "little leaf" disease. This may be cured by spraying the trees, whilst dormant, with a solution of zinc sulphate in water at the rate of ½ lb. per gallon for apples and ¼ lb. per gallon for peaches and plums. I am afraid it is too late now to treat the peaches with this strong mixture, but a spray consisting of 1½ ozs. of zinc sulphate plus ¾ oz. of white lime to 1 gallon of water may be applied after the trees have come into leaf.

Grape vines should be well pruned in July and all prunings burnt. The stems should then be swabbed with a solution of sulphate of iron ($\frac{1}{2}$ lb. per gallon of water). To prevent mildew, which causes the fruit to crack, the vines should be dusted with sulphur just before the flower buds open, after the petals have fallen and again when the fruit is the size of buckshot.

Your lawn is not affected by any specific disease, but needs nourishment. It would improve if the earth were spiked and a top dressing given of well sifted soil, preferably sandy, with which powdered tobacco scrap or compost has been well mixed. A usual mixture is 1 part tobacco scrap and 3 parts of soil. When the rains commence the lawn should be fertilised with sulphate of ammonia at the rate of 6 ozs. per 10 square yards broadcast and watered afterwards. Further top dressings and fertiliser given during the rainy season will cause the grass to grow vigorously and you should be able to get your lawn in first class condition within two or three months after the commencement of the rains.

Finally, the whole of your garden soil appears to me to be impoverished. All trees and beds should receive liberal applications of well rotted manure or compost together with fruit tree or complete garden fertiliser.

Yours, etc.

FLY KILLER.

In the cattle barns of the University of Illinois a novel fly-killing method has been put into use by Prof. R. R. Snapp, Associate Professor in the Cattle Department. At various points in the cattle sheds are dishes of a white liquid and in the centre of each dish is a thin slab of porous rubber, such as might be cut from a bath sponge. The liquid is prepared by the following formula: Two large cans of condensed milk, two ounces of formalin (formaldehdye), and enough water to make a gallon. The rubber is used for the flies to light on while getting a taste of the liquid. Attendants burn a half bushel or so of dead flies a day.

Farming Calendar.

SEPTEMBER.

FORESTRY.

All cuttings struck in sand in July and not yet transplanted into good soil should have this done as soon as possible. Preliminary sowings of eucalypt seeds should now be made, so that transplants will be ready in case the first half of the rainy season should prove favourable. The fire season will now be at its height and care should be taken to see that all plantations are protected.

CROPS.

Prepare your compost heaps. Utilise your labour to the fullest extent for stumping and clearing more land for mixed crops and for general farm development. Do not be satisfied unless each year sees more profit-earning development work effected. Good organisation of the farm work will permit of much being done without great cost. Begin marking out holes for hand check-row planting of maize, and apply manure or fertiliser. Fertilisers which are to be broadcasted and ploughed or harrowed in can be applied. Lands which have been green-manured in March or April will require a second ploughing about this date or before being seeded. Danger from frost should be past now, and crops susceptible to frost, such as potatoes, onions in beds for the summer crop and Jerusalem artichokes, may be planted where lands are moist. Pumpkins and early maize may be planted on vlei lands. Edible canna may be planted "dry" during the latter half of this month. Overhaul all implements and replace worn parts. Putting this off till the planting season may mean serious loss of planting opportunities. Ploughing and cross-ploughing should be hurried on with; also the ploughing under of farmyard manure. Make every effort to secure as good a seed-bed as possible; good seed-beds mean good stands, and good stands are all-important in securing good yields.

STOCK.

Cattle.—Ranching cattle go through a very critical time from now on. Where possible, it will be wise to keep an eye on those cows that may be expected to calve early, with a view to feeding them if necessary and seeing that they do not get too poor. The supplementary feeding of ranch stock is always a difficult problem. But a small provision of cotton seed, good veld hay, kaffir corn or sunflower silage at this time may be the means of saving many head of cattle when the rains are late. This is a critical month for young stock. Weaning should be completed as soon as conditions permit. The dairyman will carry on much as in August; he will, however, use his discretion (in accordance with the condition of his veld) as to the use of ensilage, pumpkins or other bulky and succulent food. He will be wise not to shorten the supply of concentrated foods for some time to come. A little hay or ensilage should still be kept in reserve until the rains have fallen in reasonable abundance. The object should be to build up the condition of the cows expected to calve when the rains come.

Sheep.—Same as for August, except that March lambs, if well grown, should be weaned and either put on to good grazing or allowed ample bean hay and a little maize. A little feed now will ensure that they will be ready to top the Christmas market. Where nodular worm is present dose twice at 30 day intervals as was recommended for January.

DAIRYING.

This is generally the quietest month of the year from a dairying standpoint, as the production of dairy products is at its minimum. Town milk supplies are now falling off, and a greater use of purchased concentrates in the form of ground nut cake and bran is advisable to keep up the milk supply. Very little cheese is made during this month. Old cheese should be cleared out of the store-room before the advent of hot weather, and if possible should be sent to be stored under cold storage conditions. Considerable difficulty is to be expected in making butter during this month, as the early spring grass is shooting in the vleis and the butter is consequently very soft. To counteract this, greater use should be made of feeds which produce a hard fat, such as cotton seed cake.

Breeding Diplodia Resistant Varieties of Maize

By T. K. Sansom, B.Sc., Plant Breeder.

Introduction.—Plant improvement is nearly as old as agriculture itself; records of the preservation of superior plants are found in translations of ancient Chinese literature and long before any one thought of making a philosophical study of plant improvement the hybridisation of flowers and the preservation of choice strains were commonly practised.

The great world movements of the 19th century resulted in the extension of agricultural industries and gave a great impetus to plant breeding, and the methods used may be classified under the following heads:—

1. Mass selection.
2. Line selection and progeny test.
3. Hybridisation followed by direct utilisation, or selection and fixation of new varieties.
4. Clonal selection.

Mass Selection.—Consists simply of picking out the choice plants from the main crop and sowing the seed from them en masse.

Mass selection of maize was begun as early as 1825 and the general result of this project has been the most convincing proof of the efficacy and practicability of mass selection in maize, not only for the chemical and physical characters of the grains, but for other characters of the plant as well.

Line Selection and Progeny Test.—Consists in the selection of single plants followed by separate tests of their progeny. In maize, by guarding and self pollinating individual plants for successive generations a number of morphologically distinct strains are isolated, thus proving that the original population was mixed.

Hybridisation.—Holds great promise of future possibilities, and the hybridisation of maize was begun as early as 1878. The crossing of maize strains which have been inbred for several generations has given increased production as well as new combinations of desirable characters.

Clonal Selection.—Consists of the utilisation of asexual means of multiplication and maize therefore cannot be improved by this means.

Prevalence of Diplodia.—Diplodia is prevalent to a greater or lesser extent throughout Rhodesia; infection may be as high as 100 per cent. in badly infected crops, depending on the season and the locality. It is estimated that many thousands of bags are lost annually owing to the incidence of diplodia attack.

The disease is most severe in the best maize growing districts, and there is no variety of maize grown in the maize growing districts of this Colony which shows any high resistance to diplodia. In the United States, however, diplodia resistant varieties have been produced.

In Matabeleland the incidence of diplodia attack is not so severe as in the chief maize growing areas of Mashonaland, for the simple reason that the rainfall in Matabeleland is very much less than that in Mashonaland, but in a season of very heavy rainfall in Matabeleland the writer has seen the well known varieties Hickory King, Salisbury White, and Potchefstroom Pearl as badly infected as any crops in Mashonaland. Such varieties of maize as Hickory King and Salisbury White, which are the chief varieties grown in the maize growing districts of Mashonaland, are not in themselves highly resistant to diplodia infection. They do not show the amount of infection in Matabeleland simply owing to the fact that climatic conditions there generally are unfavourable to diplodia infection. Yellow varieties and other short season varieties which are grown in Matabeleland and which may have a higher resistance to diplodia infection, are not grown in the principal maize growing areas of Mashonaland, owing to their susceptibility to maize blight and their comparatively low yielding ability.

Material Used.—Some ten years ago seed of three strains of a white dent variety known as Johnson's County White, was obtained from the United States. These three strains showed a high resistance to diplodia attack, but apart from their resistance were quite unsuitable in other characteristics. The cob was extremely small, a well grown specimen being only about 5 inches in length and proportionately small in girth. The grain itself was about the size of pop corn and there were sixteen rows on the cob.

This variety was crossed with a good type of Salisbury White, the original selections of which were made by the Agriculturist at the Government Experiment Station, Marandellas.

Selections from these crosses have been made and during the past three seasons seed of the hybrid has been distributed for trial. Generally speaking this hybrid has shown a high resistance to diplodia attack, and where it has been grown under comparable conditions with other varieties of maize it has shown a marked superiority in resistance to diplodia.

During the past season, which was extremely favourable for the spread of diplodia, samples of seed of the hybrid were sent to the Senior Plant Pathologist for germination and diplodia test. The highest *diplodia* infection was 9 per cent. and the lowest 2 per cent. The latter figure was from a flinty type grain which is the type on which selections are based.

When it is considered that it is extremely rare to find commercial seed which contains less than 50 per cent. of diseased grains, the results obtained from the new hybrid are very satisfactory.

At present this variety is still in the development stage, but in preliminary trials against other white dent varieties conducted on the Salisbury Experiment Station during the past three years, it has given promise of having equal yielding ability to our standard white dent varieties. Further improvement of this variety is still in progress and seed is not available for distribution at present.

The Farm Home

Marmalade

By Miss E. E. Coutts.

During the winter months citrus fruits are in season and are cheap. The fruit for preserving is at its best during July and early part of August, and all marmalades and preserves from citrus fruits should be made at this time. Citrus fruits include oranges, lemons, grape fruit, tangerines, pompelmoes, shaddock, etc. The principles of marmalade-making are the same as those for jam-making, except that the thick peel requires a longer time to cook than does the soft pulp of jam-making fruits. *Is is essential to remember the following*:—

(1) That the jelly-making product pectin is found chiefly in the white inner skin and not in the juice. The white part therefore must be cooked in the mixture. If not required in the finished product it may be cut up fine but roughly, tied in muslin, cooked with the fruit and removed before sugar is added.

(2) That prolonged boiling after sugar is added must be avoided. Long boiling with sugar spoils the flavour, darkens the colour and affects the pectin and this causes loss of "jelling property."

(3) That acid in addition to pectin is required to cause a proper jell, therefore in some cases where there is a great bulk of skin (when small or sweet oranges are used) there is not sufficient acid present with the pectin and it is necessary to add lemon juice, bitter orange juice, citric or tartaric acid.

(4) Shreds of lemon peel and sweet orange do not become transparent when cooked.

(5) The peel of the fruit requires long cooking to become soft and therefore a large proportion of water is added and the fruit and water should be boiled until about one-third of water has evaporated before sugar is added.

(6) The pulp should be soaked in china or earthenware basins overnight, not in metal or chipped enamelware.

PROCESSES IN MAKING MARMALADE.

(i.) *Cutting up of Fruit.*—As pectin is present in the skin of citrus fruits it is brought into solution more readily if peel is cut thinly.

(ii.) *Soaking Fruit.*—Soaking peel in the water overnight softens it. This step may be omitted if time is short, but in this case the cooking of the peel takes longer.

(iii.) *Addition of Acid.*—In order to secure a good jelly it is important to consider the total amount of acid in relation to the total bulk.

(iv.) *Boiling of Fruit and Water.*—To obtain soft shreds of skin it is necessary to boil it without sugar till tender—usually 2-3 hours according to quantities used.

(v.) *Boiling of Pulp and Sugar.*—To obtain marmalade of good colour and flavour the fruit should not be boiled longer than thirty-forty minutes after sugar is added.

(vi.) *Testing.*—Pour about one teaspoonful of marmalade on to a saucer and leave to cool. If ready it should jelly and show a wrinkled skin on top when saucer is tilted.

(vii.) *Filling Jars.*—Skim as soon as marmalade has reached setting point. Delay in removing scum causes it to cling to peel. Cool in pan till a thin skin begins to form; then stir gently and pan into clean *dry* hot jars. This stirring prevents peel rising in jar.

RECIPES.

SEVILLE ORANGE MARMALADE.

11 Seville oranges.	8 lbs. sugar.
2 lemons.	9 pints water.

Method.—1. Wash and wipe fruit, cut in half, remove juice and cut rind thinly.

2. Remove pips.

3. Add water and if time permits soak 24 hours.

4. Place fruit and water in preserving pan, bring slowly to boiling point and cook until rather less than half the contents of pan have boiled away.

5. Add sugar, stir until dissolved (do not allow to boil till sugar is dissolved).

6. Boil rapidly until a little placed on saucer will jelly. (If boiled too long it will not jell but remain sticky.)

7. Cool slightly, pour into warm *dry* jars, cover when cold.

Naartje or Tangerine Marmalade.

These fruits are unsuitable for marmalade unless combined with one or more of the other citrus fruits (grape fruit is good). Make the marmalade a jelly with only a small proportion of cooked shreds of peel added.

3 lbs. tangerines.
1 grape fruit (weighing about 1 lb).
4¾ lbs. sugar.
1 lemon.
½ oz. tartaric acid.
4 quarts water.

Method.—1. Cut peel of tangerines very thin (only use 10 ozs.), reject stringy part. Tie loosely in muslin bag.

2. Cut up peel of lemon and grape fruit.

3. Cut all pulp as fine as possible; remove pips.

4. Put fruit, peel (including that in muslin), water and acid into bowl and soak overnight.

5. Simmer about 2 hours, but remove the bag of peel after three-quarters of hour, or it will break up and make marmalade cloudy.

6. Empty bag and rinse peel in cold water.

7. After 2 hours strain the rest of fruit, but avoid squeezing out or jelly will be cloudy.

8. Bring juice and washed tangerine peel to boil in preserving pan.

9. Add sugar, finish as previous recipe.

Grape Fruit Marmalade.

Make like Seville orange, but amount of water used should be three times the bulk of fruit and peel. After first boiling measure fruit and use equal quantities of sugar, *e.g.*, to each cup fruit pulp one cup of sugar. Finish as previous recipes.

Timber Preservation

Butt Treatment

By R. H. FINLAY, District Forest Officer.

The war has led to considerably increased interest in the preservation of timber for building purposes, fencing and other uses and a number of enquiries have been received by the Forestry Division as to how to set about the preservation of poles. This Division is itself interested in the treatment of poles and a fairly large plant is being erected on the Mtao Forest Reserve. This has been designed to treat lengths of up to 38 feet and arrangements have been made for the importation of large quantities of creosote.

Creosoted poles for transmission purposes have already been purchased from the Union of South Africa by the Defence Forces and certain Municipalities and the Division hopes to supply considerable quantities of similar poles to the Electricity Supply Commission and other bodies. Such a plant is, however, expensive, and quite unnecessary for ordinary farm purposes where the butt treatment of poles is normally all that is required considerably to increase the life of timber in the ground.

Structure of Wood.—Wood is composed of numerous small cells not unlike a honey-comb with pores leading from one to the other. It may be sub-divided into two types, heart-wood which is wood, the cells of which are no longer used for transmitting food and which are frequently filled-in with various substances which seal the cells, and sap-wood, in the cells of which are to be found the sap or food solutions. There is a certain amount of moisture in all these cells and the walls of the cells also contain moisture.

Seasoning.—Before being able to get any preservative solution into the cells the sap or moisture must be removed and this involves drying for a considerable time.

To do this as effectively and quickly as possible, all bark, including the inner bark, must be removed and the poles allowed to dry for a period equivalent to at least one month for each inch of diameter. Thus a pole of 6 inches diameter should dry for six months or more when it may be assumed to be ready for treatment. Even so, it will only be sufficiently dried if it has been suitably stacked. It is useless to expect that a pole which has been lying on the ground for even as much as twelve months will be properly dry.

Foundations for a stack should be built up at least 9 inches from ground level and, of course, all weeds should be cleared from the site, so that good drainage is obtained. Poles should be laid parallel across the foundations and they should be separated by a space equivalent to about half their smallest diameter. When one layer has been laid, cross-poles or "stickers" should be placed across them at a distance of six to eight feet apart, or if the poles are short about 6 inches from either end. A new layer of poles is then laid in a similar manner on the top of these. Gum poles, which are very liable to split, should in the first place be stacked in partial shade, and it is as well to leave the trees in full lengths so that any splitting which may occur at the ends may be removed when sawing to the required lengths. After they have dried for a considerable time they should be re-stacked in an open and airy place.

At the end of the required period the poles should be sufficiently dried. Farmers who have an accurate balance weighing to $\frac{1}{100}$ grm. or less can easily test the moisture content by weighing a section from the middle of the pole. (The section from the end is of little value as it is likely to be drier than the average for the whole pole.) This section, which should be thin, is then heated at a temperature of 212° F. for a period of 24 hours and then re-weighed. The moisture content can then be calculated by the formula $\frac{W1 - W2}{W1} \times 100$ = the moisture content, when W1 = first weighing and W2 = second.

Thus a piece weighing 5 grms. to start with and 4 grms. after heating would have a moisture content of

$\frac{5-4}{5} \times \frac{100}{1} = 20\%$. This percentage of moisture (i.e., 20%) is what should be aimed at in order to get sufficient impregnation of the preservative solution.

Preservatives.—Various preservatives are available.

Creosote is probably the best of these and by far the most universally used. It can be used pure or mixed with a proportion of fuel oil. The proportion varies considerably, but in Africa 20% is normally employed. Unfortunately, creosote is not at present obtainable locally. Large quantities are manufactured in the Union of South Africa and the extension of the Steel Works now being built is expected to increase greatly the supply available in 1941. Nevertheless the demand is so great that no export is being undertaken. It may be imported from England and landed at approximately 1s. 3d. per gallon, but it is doubtful whether small orders would be considered and shipping facilities are extremely limited. Its use is therefore largely ruled out for the present. Wood treated with creosote is unsuitable for interior work owing to the smell and to the fact that it does not take paint.

Arsenious Oxide.—This salt, which is a white powder, is used generally as a 3% solution in water. It is highly poisonous and must be handled with great care. Like other water soluble salts it is inclined to leach out of the timber when exposed to the weather.

Sodium Arsenite.—This is similar to arsenious oxide and may also be used as a 3% solution. 3¾ lbs. of the powder are required for 10 gallons of water. Both these salts are dangerous to cattle as well as to human beings, and cattle lacking salt in their diet are liable to lick treated posts and so become poisoned.

The danger is somewhat minimised when only butt treatment is given, but it must be borne in mind that butt treatment to be effective must allow for at least 12 inches of treated timber above ground level. Probably a subsequent application of old motor or engine oil after treatment with arsenic salts would tend to prevent the leaching of these salts and would mask the attractive salty taste.

Zinc Chloride costing, if available, £4 or more per cwt., is used as a 5% solution. It is largely made in Belgium and it is consequently doubtful whether sufficient supplies for export are available from other countries. It leaches out very readily and is somewhat difficult to handle in small quantities, as the solid salt rapidly absorbs moisture on exposure to the air with the result that after a short time the mixing of, say, 5 lbs. of this pressure liquified salt in 10 gallons of water will give a 5% solution. It is of value as a prevention against borers, etc., in interior work, but of limited value outside, especially after set in the ground. Zinc chloride in strong solutions corodes metal tanks, and corrosion is especially liable to occur where the solution is splashed up on the side of the tank and subsequently evaporates.

Tar is not of very great value, as it dries and flakes off in a few years and penetrates into the wood very slightly, if at all. It can be used as subsequent treatment after water warmed salts to prevent leaching.

Wolman Salts, or Tanalith, is a proprietary preservative containing sodium fluoride and a number of other salts. It is in the form of a powder and costs about 2s. 3d. per lb., being used in a 2% solution, *i.e.*, 1 lb. to 5 gallons of water. It is understood that this leaches out comparatively slowly and is of considerable value both for indoor and outdoor work.

Atlas A. is also a proprietary preservative sold at 13s. 6d. per gallon. For immersion processes it can be diluted to 16 gallons. It is poisonous.

Cattle Dip.—This is available on most farms and is composed mainly of arsenite of soda. The ordinary strength as used in dips is insufficient, but to make a 3.2% solution half a gallon of pure liquid dip should be added to ten gallons of water.

There are, of course, numerous other proprietary preservatives.

Under war conditions the arsenic salts will be the most readily available and are also the cheapest.

It is again emphasised that there is danger both in their handling and use, but the latter could probably be minimised by covering the treated portion with oil or tar.

While it is proposed mainly to discuss the immersion process of treatment in this Bulletin, it may be as well to mention the others. These are:—

(1) *Brush Treatment.*—This is frequently applied, especially on timber to be used in interior situations. For this purpose a strong solution (generally at least double strength) is used and if the timber is treated two or three times it may be considered fairly satisfactory. It is not, however, recommended for use in the ground.

(2) *Pressure in Cylinder or Closed Tank Method.*—This is a rapid and efficient method largely used commercially. It involves a heavy expenditure for the cylinder and pumps which are used for putting pressure on the solution and forcing it into the timber. Generally a vacuum-pump is also employed which extracts surplus preservative in the wood.

(3) *Open Tank Treatment.*—Tanks for the solution vary considerably in shape. Generally speaking they should be deeper than they are wide, but the length will vary according to whether it is desired to treat whole lengths or small butts.

Drums can be used for treating butts and troughs for long lengths. Tanks must be strong enough to hold the timber without buckling and must be leak-proof. Wooden tanks can be used for corrosive salts such as zinc chloride, but this entails the use of coils for heating. Generally speaking long troughs are heated by means of steam coils as opposed to direct firing. Drums are generally heated with a fire underneath. Timber may be immersed in cold liquid, but penetration is only superficial and takes considerable time.

Impregnation.—The theory of impregnation is that the wood must be heated for a sufficient period to expel as much of the air in the cells as possible. As the wood heats, the air expands and is forced out. When the wood is again cooled a partial vacuum is formed in the cells which draws in the liquid preservative solution. The timber and solution should be heated up to between 180° F. and 210° F. and maintained at that temperature for at least three hours, and then allowed to cool for 15 to 20 hours. In the case of large timber it will be necessary to heat the tank for a longer period in order that the inner portions of the wood shall become adequately heated. The aim is to cool through at least 100° F.

Enemies of Timber.—It may now be as well to consider the objects of treatment and the damage it is proposed to prevent.

Termites, or "white ants," come first in most people's thoughts, followed by rot, which is most liable to take place at the "wind and water line," or ground level. Borers must also be considered, but are of less importance and danger in sound dry timber.

Borers, in fact, are mainly a menace if the bark is left on, as the beetles almost invariably lay their eggs between the bark and the wood. If, when felling, this nursery is destroyed damage is much less likely to occur.

Butt Treatment.—It may therefore be said that butt treatment for ordinary outside farm work is satisfactory provided the treated portion extends at least 12 inches above ground level. The untreated portion is likely to remain sufficiently sound, more especially if the top of the pole is cut on a level to allow water to run off.

The following table indicates the length of butt which should be treated for a given length of pole:—

Length of Pole	Butt Treatment.
. 6 ft. 6 ins.	2 ft. 6 ins.
7 ft.—12 ft.	3 ft.
14 ft.—16 ft.	3 ft. 6 ins.
18 ft.—20 ft.	4 ft.
22 ft.—24 ft.	4 ft. 6 ins.

Butt treatment involves considerably less expense both in plant and preservative. An ordinary 45 or 90 gallon drum can be used, or better still two such drums can be welded together.

This is as a matter of fact considerably more convenient, as the height of a 45 gallon drum is 33 inches. Consequently, although a fence post may be covered for the requisite depth of 30 inches to start with, the liquid level rapidly drops on cooling and absorption by the wood with the result that only about 18 inches is fully and properly treated.

It would, of course, be possible to maintain the preservative level at the proper height by adding more as it is absorbed, but this is not very satisfactory.

The simplest method of heating is over an open fire, the tank being raised on brick piers with metal supports laid across them. (Fig. 1.) It is also possible to have an external pipe joined either to another tank (Fig. 2) or returning to the tank at a point about half way up. Although this method results in a longer life for the tank, it takes longer to heat the liquid and more wood is used.

Perhaps the best method of all is to build a brick grate and a chimney in such a way that the draft draws all the heat under the tank, Fig. 3.

If the method of two welded 45 gallon drums is adopted it is possible to treat a length of about 4 feet or more, and in the case of fence posts it is thus possible to turn them end for end and thus heat the whole length.

Operators will find it necessary when treating longer poles to have some means of support for the tops, the weight of which would otherwise upset the tank. It is a simple matter to rig up some form of trestle made of poles against which to lean the tops of the poles.

As has already been pointed out, the essential period is the cooling period during which the partial vacuum in the cells sucks in the preservative.

Butt treatment in an ordinary 45 or 80 gallon drum suffers from the disadvantage that only a small number of poles can be treated per day.

If the poles are not too difficult to move, this difficulty can be overcome by having extra cold tanks. When the timber has been heated in hot solution for a sufficient time, it can be removed and replaced *immediately* in a cold tank, and a new charge put in the heating tank.

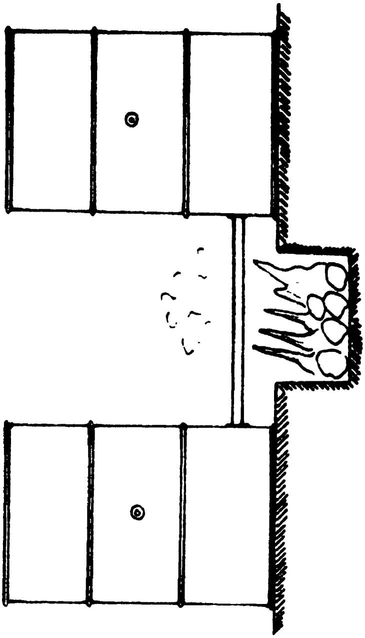

FIG 2

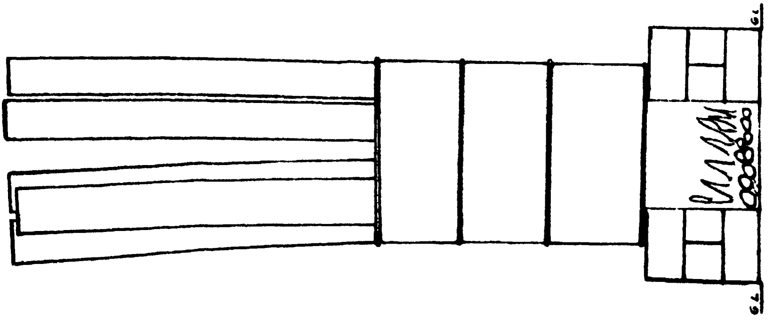

FIG I

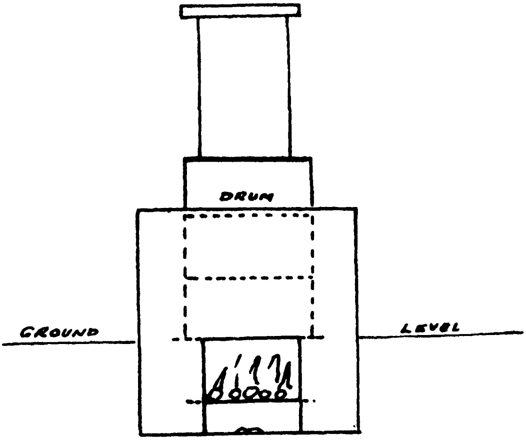

FIG 3 a

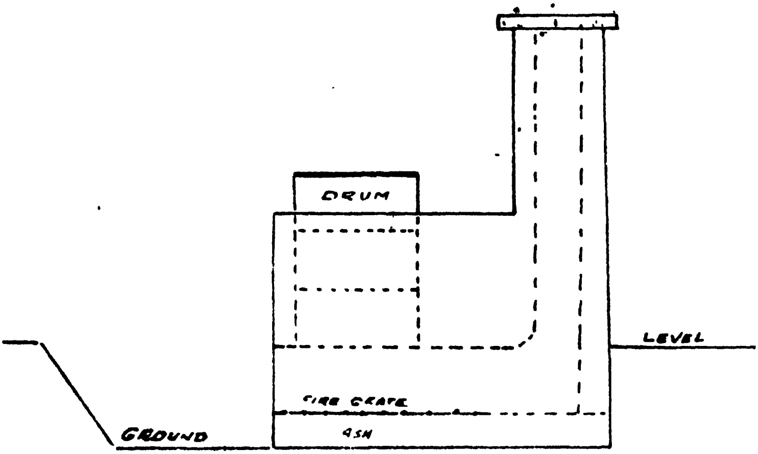

FIG 3 b

SUMMARY OF OPERATIONS.

1. Bark timber when felled. If even the smallest strip of bark is left it will be a weakness as no impregnation will take place underneath the strip. Stack off the ground with poles between each layer for a period equivalent to at least one month per inch of diameter.

2. Heat in correct strength of solution for at least three hours at a temperature of 180°—210°.

3. Cool for 20 hours through 100°.

The amount of solution to be absorbed should be at least 10 lbs. or 1 gallon per cubic foot if possible.

Large poles with a large proportion of heartwood will absorb less as the heartwood does not absorb the solution, except superficially.

Most farmers may have difficulty in estimating a cubic foot, but the following table gives the approximate sectional area in square feet against the appropriate mid-diameter:—

Inches.	Sectional area. Square feet.
4	.09
5	.14
6	.20
7	.27
8	.35
9	.44

Intermediate diameters can be interpolated with fair accuracy.

Thus a pole of average diameter 6 inches and 6 feet 6 inches in length has a volume of 0.20 x 6.5=1.3 cubic feet. If weighed before and after treatment the difference in weight divided by 1.3 will give the absorption per cubic foot and a guide as to whether treatment has been sufficient.

It should be borne in mind, however, that if only one-third of the length of the pole is being treated the volume to be taken into consideration is that of the treated portion only.

Results of Treatment.—The length of life given by this treatment is unfortunately difficult to state and will in any case vary with the site and the preservative used.

Tests have for long been in progress in the Union in areas heavily infested with termites and indicate for creosote a probable life of at least twenty years in a sound condition.

Arsenic salts are understood to give about half this life and zinc chloride is not advised for situations where the timber is placed in the ground.

Experiments have also been carried out in Northern Rhodesia in a site where termites are very numerous.

Here, 23 out of 30 untreated controls of different kinds were attacked within the first year and some were entirely destroyed, whereas the pieces treated with arsenic salts were entirely sound.

After four years five native species still showed little or no sign of damage and a further four, although attacked, were still serviceable. Six species lasted 3-4 years and the balance failed before that time.

On the other hand, all the 58 pieces treated with arsenic salts were still serviceable. Five of them showed signs of termite attack, but in no case had more than 8% been eaten. A further nine specimens showed signs of fungal decay, but apparently to a negligible extent.

Zinc chloride gave poor results.

Cost of Treatment.—Taking these figures as a basis it is interesting to see the value of treated as opposed to untreated poles.

Supposing therefore that it is possible to treat in a 45 gallon drum 10 poles per day, we might assume the labour cost of wages and cutting wood to be 2s. 1d., or 2½d. per pole.

If dip costing 8s. per gallon is used the cost of solution will be 4.8d. per gallon.

A pole of 6 inches diameter and 2 feet 6 inches in length has a volume of approximately 0.5 cubic feet. The value of liquid absorbed should therefore be 2.4 pence, or say 2½d., making a total cost 5d. per pole.

We now have to analyse the value of a pole lasting, say, eight years as opposed to an untreated life of, say, two years, and here it is necessary to introduce compound interest and the so-called sinking fund method of determining annual service charges. These annual charges represent the equal annual payment which at compound interest will provide for renewal at the end of the life of the timber without any scrap value for the timber.

The following table shows the annual service charge in an original unit cost of 1 computed at 5% compound interest.

Years.	Annual Cost.
1	1.050
2	.530
3	.367
4	.282
5	.231
6	.231
7	.173
8	.155
9	.141
10	.130
11	.121
12	.113

We can now return to the pole and assume that its untreated cost erected and set in the ground is ninepence.

	Treated.	Untreated.
Cost of post and setting	9	9
Cost of treating......	5	—
	14	9
Life, years, say	6	3
Annual Service Charge	14 x 197 = 2.758	9 x 367 = 3.363

The treated pole is therefore cheaper to maintain. If a non-durable pole is chosen lasting only two years the cost per annum is 4.770 pence.

Certain native timbers are, of course, very resistant to termites. These are known by natives and include such timbers as mopani, m'susu, m'karati, umgusu, etc.

One thing remains to be said. The wood must not be cut or sawn after treatment. Solution will not penetrate right through the pole; in fact, it may not go further than ½ to 1 inch. If therefore the pole is cut after treatment and untreated wood exposed, the treatment is rendered largely valueless.

Acknowledgements.

The Utilisation of Wood. T. L. Wilkinson, M.Sc., B.Sc.F.

Preservative Tests and Durability Trials with Native Timbers of the Copperbelt of Northern Rhodesia. C. E. Duff, M.A.

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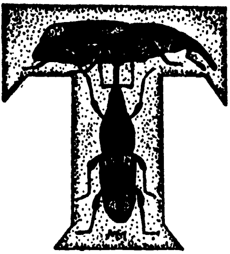
Miscellaneous Publications. Forest Products Research Institute, Pretoria.

Control of Maize Weevil

(*CALANDRA ORYZAE*, L.).

By M. C. Mossop, A.F.C., M.Sc., Entomologist.



THE destruction caused in stored maize in Southern Rhodesia by insects, mainly Maize Weevil, represents an annual loss of £20,000 if we take the arbitrary and unaudited average figure of two pence loss per bag for the 2,400,000 bags now grown yearly by Europeans and natives. Possibly the position is understated, but every penny average loss per bag means a loss of £10,000 at the average production rate for the last ten years. Much of this could be saved for more constructive purposes through a superficial knowledge of the life history and habits of weevil and a true understanding of an important cycle which we have created in its economy, and which offers this insect opportunities apparently undreamed of by Nature.

SHORT DESCRIPTION OF LIFE HISTORY AND HABITS.

The Maize Weevil (known elsewhere as the Rice Weevil) is too well known by farmers, produce merchants, and others to need description, except that many fail to distinguish it from the small brown elongated and flattened flour beetles (*Tribolium* spp.) that are secondary pests in grain infested by weevil. In Rhodesia it is sufficient to recognise the dark brown to black coloration and the slender forward-and-downward projecting "snout" of the weevil, combined with its presence in maize, to be able to assume with reasonable certainty that it is Maize Weevil (*Calandra oryzae*, L.). Four indistinct pale patches on the hinder part of the back, *i.e.*, on the wing covers, are enough to distinguish it from the Granary Weevil (*Calandra granaria*, L.), which, forunately, is not known to occur on Southern Rhodesian farms.

The form of the weevil commonly recognised and briefly described above is the adult weevil. Adults may live for six months or more. The longevity of weevils is dependent on conditions. In warm, humid weather, they are more active than in winter and do not live as long.

Deprived of food and water, adult weevils will die in about a week in the comparatively moist and temperately warm conditions of the rainy portion of Southern Rhodesia's summer. Under these climatic conditions and with varying accessibility to food in preliminary tests made in Salisbury, weevils of unknown and mixed ages collected in a warehouse were able to live to the seventh and eighth days without food or water; to the eighth day outside a fine-meshed cloth bag containing whole maize; to the twenty-fifth day without food but with water absorbed in washed sand; to the eighty-fifth day outside a fine-meshed cloth bag containing maize meal; and to the 105th day with complete access to maize grains.

Although the Maize Weevil has wings, it seldom flies when the temperature is low. In warm weather, however, careful watch will reveal it flying in and near maize sheds, attracting swallows to the vicinity. Swallows may often be seen following maize trains, for many weevils, when disturbed by movement or vibration of grain which they are infesting, tend to come to the outside of the bag and often take to flight. Before flight, the insect climbs to a point of vantage, being apparently unable to take off from a flat surface. Incidentally, it may be mentioned that the *Granary* Weevil cannot fly, and this fact probably accounts for a somewhat widespread local belief that the *Maize* Weevil is unable to do so.

The adult female lays an egg in a shallow pit which she chews in the surface of the grain, and then covers it over so that it is protected and not easily found. She has been known to follow this procedure for as many as 400 times during her life-time, though the figure would normally be nearer 100.

About five or six days after the egg has been laid in the grain, a small legless grub hatches out and begins to feed inside the grain. Its whole life as a grub is usually spent within a single grain, and for this reason the grub remains unnoticed. About three to six weeks are spent in growing to full size. When the grub is fully developed it becomes a pupa, still within the grain. The pupa does not feed, but develops in about five to twelve days into an adult weevil, which may feed for several days before emerging through a characteristic and unwelcome hole which it makes in the skin of the grain.

Thus the process of development from egg to adult can occur within the grain in as little as a month under favourable conditions. The period is more often about twice as long as this, and in winter it is considerably lengthened.

It will be noticed by some that no "moth stage" is mentioned above. It should be emphasised in this connection that no moth stage whatever occurs in the development of Maize Weevil or of any other beetle. The moths that are seen flying about maize stores have developed either from caterpillars (of *Sitotroga cerealella*, Oliv.) which feed on the maize or, more commonly, from caterpillars (mostly of *Ephestia kuehniella*, Zell., and *Plodia interpunctella*, Hbn.) which when in grain stores feed mainly on "weevil dust."

THE PROBLEM.

In the development of our agricultural methods we have massed our growing crops together in such a way that weevils breeding in the fields can easily find an abundance of food supplies without resorting to the search which each generation would find necessary under entirely natural conditions. This is considered unavoidable, but there are means of mitigating the effects, as we shall see later. Secondly, we mass our harvested grain in such a way that weevil food is concentrated in a manner most acceptable to the insects. Thirdly, we create a cycle by allowing weevil from the store to infest the lands, and by bringing weevils with the harvested crop to infest the store. In order to attack the problem properly, we must break this cycle *wherever possible*, which means that we must stop or reduce the breeding of weevil everywhere. Some of the methods of attack cost nothing more than a rearrangement of plans or nothing more than an improvement in methods which, weevil or no weevil, is desirable. Others cost money. A combination of them all is necessary, and is in the final account believed to be profitable.

In the advice and suggestions which follow, details of observations or experiments on which they were based are in most cases omitted for the sake of brevity. Whilst it is hoped to publish on the subject later, their inclusion here would be unnecessary and cumbersome. It may be stated, however, that all the advice and suggestions presented in the body of this article are based on observations made or confirmed in Southern Rhodesia, unless otherwise indicated. Likewise, the co-operation of Rhodesians is sought, for, to be nationally effective, the control of weevil by what amounts to little more than simple modifications of existing routine should be carried out on a community basis. No attempt is being made to persuade the farmer to adopt ideal but impracticable methods. Whilst one or two suggestions may be only on the border-line of practicability at present; it is confidently expected that the ingenuity of farmers will bring them within that border-line. Local observations have indicated that if the control of Maize Weevil along the lines suggested in this article is conscientiously attempted, the beneficial effects should *accumulate from year to year* until the problem is of secondary importance.

TERMINOLOGY.

Owing to the looseness of the terminology used in Southern Africa in connection with the fruiting head of maize, it is thought advisable to explain the terms used in this article. The "core" refers to the central pithy portion deprived of its grains. The "ear" refers to the core with the grains on and with or without the covering sheath, according to circumstances. This in itself is admittedly vague, but there is apparently no popular term that includes the whole assemblage except by inference. The "sheath" is used to indicate the outer covering, and "husk" is also used in this connection. The word "cob" has been eliminated, for in Rhodesia it usually refers to the ear, whereas in the United States it refers to the core (*e.g.*, "corn cob pipe," "corn on the cob").

FIELD INFESTATION.

Growers are coming to realise that infestation in the lands exists, although many deny infestation in their own lands. The writer has challenged numerous growers, and has failed only once to demonstrate within a few minutes the presence of weevil in their lands. The farm in question had previously been locally notorious for weevil infestation, but a recent alteration in organisation accounted for the change.

Attack by Maize Weevil in the field is heaviest near the chief sources from which the land is infested, *i.e.*, storage sheds, shelling dumps, native compounds, railways, etc. Moreover it is, in a large part if not completely, confined to ears that allow access to the adult weevil. The weevil itself is not known to chew its way through the sheath of an ear in order to gain an entrance. Mutilation or deformity of ear or sheath may be due to insects, diseases, or other causes.

A certain amount of weevil probably infests the lands throughout the year, most likely in crop refuse when there is no standing crop, but this has not been demonstrated locally. But in any case refuse already present can support weevils newly infesting the lands from outside sources such as shelling dumps, etc.

From the foregoing facts it follows that we should:—

Keep lands clear of crop refuse at all times.

Select seed only from the standing crop and discard any ears that are injured in ANY way and that do not have a long, unbroken, tight sheath.

Use only seed treated against diplodia and other diseases.

Utilise or destroy shelling dumps as early as possible.

Grow cereal crops as far from sources of infestation as other considerations will allow (without allowing other considerations undue weight).

Where ensilage is made from the whole plant, use the maize growing nearest to sources of infestation, and plough and clean up the land as early thereafter as can be made convenient.

The above operations are all consistent with one another and are not alternatives. They should *all* be carried out. Seed selection is important not only for the obvious reason of avoiding the retention of weevilled seed, but also for the reason that it is desirable to reproduce characters inimical to weevil infestation in the succeeding crop. It is desirable, therefore, to breed away from any susceptibility to deformity or mutilation of ear or sheath that can be eliminated or reduced by selection.

Some incidental observations made in regard to probable causes, hereditary or otherwise, of deformity or mutilation facilitating the entry of adult weevils are as follows:—

1. Short sheath as a hereditary character.
2. Attack by fungous diseases affecting the ear.
3. Attack by insect pests such as ear-worm, long-horned grasshoppers, etc.
4. Curving of tips, possibly due to 2 or 3 above or to irregular fertilisation.
5. The falling of plants as the result of attack by termites or diplodia, or as the result of wind or other influences, and subsequent attack by termites on the ear of the fallen plant.
6. Rubbing of sheaths against the stalks in the wind.
7. Bisexuality in ears or tassels.
8. Multiplication or sub-division of ends of ears.
9. Swelling of grain after cessation of sheath growth.
10. Loosening of sheaths on drying.
11. Removal of portions of ears by livestock, game, etc.
12. Examination by humans.

Some of the above defects can be reduced or eliminated by field selection, and in practical seed selection it is preferable to suspect them all. Other ears growing on the same plant need inspection before the proposed ear is decided upon. Recent advice given by the Agriculturists and the Senior Plant Pathologist of the Department should, of course, be followed.

Shelling Dumps.—As already indicated, one of the more important sources of infestation, and possibly second in importance to store rooms, is shelling dumps. These may consist of cores or husks or both. On the whole, there are more dumps near the lands away from storage sheds than there are near these sheds, and each of these acts as an additional source of infestation. Whilst it may be extremely difficult to find any weevils in a shelling dump, field surveys have left very little room for doubt that infestation takes place from them. They should, therefore, be disposed of as early as possible, certainly not later than early November, but preferably before the commencement of the hot season. If they are to be converted into compost, the top soil to be used for composting should be taken from as large a proportion of the area of shelling operations as possible. If they are to be burned, the material should be spread to cover as much of this area as is consistent with obtaining complete destruction by a hot, soil-penetrating fire. Shelling dump areas that are to be fenced prior to making compost should be completely included. It can be inferred from the foregoing that shelling operations should be confined to as small an area as possible, and this should be kept in mind when these operations are being planned.

STORAGE INFESTATION.

If we have paid sufficient attention to the field infestation, the initial storage infestation will be considerably lower than is normally the case. This may not be noticeably so, for initial storage infestation is usually more or less unnoticed in any case. But even a few weevils can produce sufficient progeny to cause considerable damage during the normal period of storage. The cry that maize delivered for storage at railhead becomes infested only after delivery is largely discounted. The same maize stored in a new shed on the farm would soon show signs of weevil. Where do they come from? Mostly with the maize from the lands, and only partly from machinery and used bags, or new bags that have been stored near weevilled grain, or other minor sources.

Whatever the origins of storage infestation, we must make some effort to prevent it, to check its increase, or to eradicate it. Such an effort should commence before the grain is stored, and not be postponed until the infestation becomes obvious in the spring or summer, for by this time there is potential damage very many times as great as the damage already observed.

We know that the drier the maize the less it encourages the breeding of weevil. This was demonstrated on a country-wide scale in 1937, when an unseasonably heavy infestation brought in from the field with the new crop failed to increase throughout the dry months on account of the low moisture content of the grain. The result was *a sub-normal storage infestation* and, consequently, *a sub-normal field infestation in the succeeding crop.*

We know that stored maize gives off carbon dioxide. This will kill weevil in a sealed container full of grain, although a slight leak has been known to reduce or nullify the effect. We know that weevil can be killed by temperatures not harmful to grain, and that their breeding can be interrupted by temperatures between these and normal. We know that dead weevils can neither feed nor breed.

To apply our knowledge we should do all the following, as far as they are consistent and as far as they can be made practicable in each individual case:—

Dry the newly shelled maize before storing it.

Empty and clean stores several weeks before the new crop is brought in, and keep them clean.

Store maize in bulk in tanks or in bins of concrete or reinforced brick, filling them to the top and then sealing them.

Stack bagged grain as closely and compactly as possible.

Insulate stacks of bagged grain from loss of heat.

Let us examine these points in further detail:—

Drying of Maize.—It is important that maize be dried out thoroughly before being stored. This can be done by following or modifying practices already in vogue. A start can be made when the maize is still in the field. Those who adopt the practice of using maize tops for silage are allowing more wind and sun to get at the ears, and this assists them to dry. The use of tops for silage is not recommended if it interferes with the use of whole plants that are growing near stores or other sources of field infestation.

The practice, when reaping, of leaving maize in small heaps to dry out is of advantage when the soil is dry. The heaps should preferably be spread out into a single layer, and the ears should be picked with only a small portion of husk, if any at all. Drying is more rapid if the ears be spread out on a cement or brick floor or large rock. This is sometimes practicable, and can often be *made* practicable. (Drying near sources of infestation may expose the grain to weevil attack unless the drying is very thorough.) Pigeon hole stacking, used chiefly to reduce moisture sufficiently to render storage safe from over-heating and moulding, should be increased as a routine practice to reduce moisture still further in order to render the grain less suitable for weevil infestation. Pigeon hole stacks should be built on poles or railway sleepers rather than directly on husks or cores.

In cases of extreme moisture, or even as a routine if it can be made practicable, artificial drying can be resorted to. Some notes on the subject were published by Mr. H. P. D. Dimmock in this *Journal* in July, 1934, and were based on experimental and profitable drying carried out by Mr. E. G. Birch. Whilst the process described is not offered as a practicable routine, except in special cases, it shows what can be done when necessity demands. The present writer, believing as he does that there are as good brains on the farm as ever came out of it, hopes that farmers will be stimulated to develop a practical method of routine drying of maize to well below the officially required maximum.

Store Cleanliness.—Cleanliness in store rooms has the effect of making an infestation more easily noticeable, of clearing away refuse in which miscellaneous pests of stored products breed, and of disposing of large numbers of weevils and other insects which are swept up in the process of cleaning, thus preventing their further breeding and therefore reducing potential damage. Stacks, rafters or ceiling, and walls should be brushed regularly, and then the floors well swept and the debris destroyed immediately by burning or other means fatal to insects. It is important that the neighbourhood of stores should likewise be kept in a clean condition.

Periodical winnowing or other handling of grain tends to check an infestation.

Storage sheds and their vicinity should be emptied and cleaned as early as this can be done before the new crop is stored. It is frequently quite practicable to pigeon hole stack the few bags of maize remaining at this period in a tobacco curing barn, as it will usually be towards the end of the tobacco curing season. The barn can then be fired for several days and kept in a dry condition. The heat will kill the weevil, and the maize can be left in the barn until it is wanted for consumption.

Bulk Storage.—Storage in bulk on the farm is becoming increasingly popular. Corrugated iron tanks have perhaps been the favourite receptacles for bulk storage in the past, but reinforced brick bins are gaining in popularity. Concrete silos are built by larger employers of labour, but are probably economical only if both needed and built on a large scale. Half-way measures in the form of large rectangular brick bins are adopted by some, and these will probably lead to storage in circular reinforced brick bins eventually. (For details of brick bins, see Appendix B.)

Storage receptacles, especially metal tanks, should be sheltered from the sun, for it is believed that heating by the sun on one side of the tank drives some of the moisture from the grain there to the cooler side, where it condenses and results in a higher moisture content in this grain, giving rise to moulds unless the moisture content throughout is very low.

A tank filled with maize and hermetically sealed accumulates sufficient carbon dioxide to kill weevil in the grain.* Under practical conditions, however, this method of control cannot always be relied upon for complete control. A slight leak is sufficient to reduce protection. Furthermore, most of our farm-stored maize is periodically tapped for native consumption, fresh air taking the place of maize each time a supply is drawn. But tanks and bins, if properly constructed, are admirably suited to fumigation, the cost for materials for each fumigation in them with carbon bisulphide being rather under one penny per bag at present prices. It is hoped to halve this cost with methyl bromide when supplies are available in Rhodesia. (See Appendix C.)

For those who do not feel justified in building a bin capable of holding all their requirements, a good plan is to erect a small one holding, say, about 100 bags to be used towards the end of the storage season. This can be situated in the storage shed, provided that there is space for the addition of further bins. Otherwise an inexpensive thatched but rain-proof verandah can be built on to the shed, or if this is not high enough a separate shelter without walls can be constructed nearby. The latter is preferable from the point of view of disposal of fumigating gases. By increasing the number as conditions permit or demand, a battery of tanks or bins can thus be accumulated gradually until all storage requirements are being met, but it should be borne in mind that they must be so placed that no spaces inaccessible in cleaning operations are left. The outlets and manholes should receive especial attention and be made as air-tight as possible. The receptacles should be filled to the top and sealed properly, and none should be drawn upon until the previous one has been emptied and cleaned out. An inspection of the top maize and that at the outlet every month or so will tell whether fumigation is necessary.

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*In South Africa certain farmers place a lighted piece of candle in the bin before sealing it. This burns up much of the oxygen present and produces additional carbon dioxide.

Apart from the easy and efficient weevil control effected by this method of storage, the saving of bags and the decrease in opportunities for their theft are obvious. Bags may be needed, of course, for bringing the maize from the shelling dump to the store, but the same bags as are used for carrying the ears from the lands to the dump can, presumably, be used for this purpose.

It must always be remembered that grain over 12.5% in moisture content must not be placed in bulk storage until the moisture has been brought down to not more than this amount. The lower, the better.

Storage in Bags.—Until such time as bulk storage becomes the rule rather than the exception, many farmers will continue to use the inferior method of storing in unprotected bags and suffering loss from insects, theft, vermin, and stolen bags, aside from suffering the mental uneasiness experienced each time they see their insect-ridden stores. As long as this practice is in vogue, they can at least obtain the benefit of the simple routine of cleanliness discussed above. Other suggestions for improving conditions in a stack are tighter stacking and insulation of stacks from loss of heat.*

A simple but important change that can be made at the cost of a little supervision is in the tightness of stacking the bags. On most farms the bags are stacked far too loosely. Each bag, especially those on the outside of the stack, should be placed slightly overlapping its neighbour at one end, and the overlap beaten tightly down into a flush position. It is indicated in experiments that the heat developed in a stack is indirectly or directly largely responsible for the comparative absence of weevil damage inside the stack, as is explained in the next section, and that the loss of this heat from the peripheral bags allows weevil to breed there. This heat is less efficiently preserved in loosely packed stacks. As most of the weevil damage in a tightly packed stack is confined to the peripheral bags (*i.e.*, sides, ends, top and bottom) stacks should be built as nearly as feasible in the form of a cube, for in practical tight stacking this produces the smallest number of peripheral bags obtainable.

In our large stacks over a quarter of the bags are peripheral bags; with 300 bags, more than two-thirds. Placing more than one row of stretcher bags to each row of header bags would result in a lower number of peripheral bags. The advantage in this would be that a smaller number of bags would be badly infested by weevil, though the actual amount of infested grain would be about the same.

Insulation of Stacks.—In attempting to discover a means of reducing infestation in bagged grain without the use of insecticides but by modification of methods of handling and storing, a most important question that seemed to need answering was, "Why is severe infestation practically confined to peripheral bags?" The writer failed to find the answer in the literature available to him.

Conditions prevalent in a large maize stack were therefore examined. Records were kept of the temperature in

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*Some farmers claim success in the use of dried Mexican marigold (*Tagetes minuta*) between each two layers of bags throughout the stack as a repellent. G. Barathon in *Rev. agric. Nouvelle Caledone* 1934, pp. 1657-1663, published in Nouméa, states that *Datura stromonium* (stinkblaar) crushed and rubbed on the lower parts of the walls of granaries is a very effective repellent.

inside and in peripheral bags for seven months, and of atmospheric humidity in these bags for the last few weeks of this period. They showed that the inside bags were higher in temperature and lower in atmospheric humidity than the peripheral bags. Moisture tests showed that the grain in the inside bags was drier. This result was a surprise to local warehousemen and dealers, and the writer did not, at first, expect it. However, it can hardly be regarded as new, for years of moisture testing and of experience in the heating of grain must, if conditions are similar in other countries, have made the true facts evident elsewhere. No significant difference between the carbon dioxide content of the air in the inside bags and that in the outside bags was found, though the popular idea was that the presence of this gas in lethal quantities was the cause of weevil control inside the stack. Further, laboratory tests showed that the moisture content of maize is dependent largely on the relative humidity of the air surrounding it, and only slightly on normal temperatures.

From the foregoing, it can be inferred that in a maize stack the total moisture present is reflected by lower relative humidities when the stack warms up, and the maize consequently dries out. Because the peripheral bags lose their heat, and thus do not have their atmospheric relative humidity reduced, the maize there does not dry out to the same extent. It is indicated, therefore, that the reason for the confinement of severe infestation to the peripheral bags is that the grain in the inner bags dries out to a point unfavourable to the continued existence of weevil, whilst the grain in the outer bags does not. Alternatively, the temperature in the inner bags may be directly responsible for the reduction in breeding there. Whichever be the cause, it would be expected that if the peripheral bags were prevented from losing the heat generated by the grain, they could be saved from severe infestation.

Preliminary experiments in insulation of stacks from loss of heat have led to the proposed adoption of the following procedure in projected further experiments: The stack to be built on dunnage of poles or sleepers. The bottom and top layers to be of bags of shavings from a wood-planing machine or bags of sawdust. The sides to be jacketed with quilts made of sacks each containing about 12½ lbs. of wood shavings, the shavings to be evenly distributed in the bags and the latter sewn across in three places, making four compartments. The quilts thus made to be hung vertically against the sides of the stack by means of "S" shaped hooks made of wire. (A more expensive and less handy means of hanging the quilts is to sew about one-sixth of a sack to the end of each quilt, and tuck it between two layers of stacked grain.) The quilts to be hung on each alternate horizontal row of sacks on the outside of the stack, overlapping each other slightly. A quilt is wider than a sack stuffed with grain, but because of overlapping, the number of quilts on a row of header sacks of grain can be made to equal the number of sacks of grain. Hanging the quilts on alternate rows of grain results in further overlapping, each quilt being made to overlap portions of two adjacent quilts below it. The sides of large stacks are usually built to slope inward with height and the quilts hang snugly against them.

Tests have shown that peripheral bags protected in this way are little, if any, more weevily than inside bags. Both have been graded by an official grader as "Slightly Weevilly" after several months of storage, whereas unprotected peripheral bags have been graded "Weevilly." Protected peripheral bags have a moisture content similar to that of inside bags—possibly slightly higher—and lower than that of unprotected peripheral bags.

Adaptations of this method to farm use can be made to suit circumstances. Cut chaff or cut grass can be used instead of shavings or sawdust. Bags for holding it can be dispensed with if a wire netting or similar screen, rather higher than the stack, be erected a foot or so from the wall and the stack built on dunnage and insulating material several inches inside the screen. Insulating material is then stuffed in between the screen and the stack, and also placed on top. (Beware of fire.) As grain is removed, insulating material must be replaced, and it would therefore be wise to have quilts on the side from which the grain is to be removed, as they are easily replaced. It is possible that fine-meshed screens or bags for quilts can be made of grass or bark by native women. Another suggestion is the making of insulating mats of a convenient size out of bundles of long dry grass.

Whether the conditions brought about by insulating a whole stack as described above, or by adaptations, will favour the breeding of rats is not known. In one insulating experiment carried out under rat-ridden conditions there was no trouble that could be traced to the insulators, but only a very small portion of the stack was insulated and no indication of what would happen if the whole stack were insulated was given. It is not expected that any more than normal trouble would follow. It is even likely that the nests would be made in the insulators rather than in the maize. In any case, whether insulators are used or not, it is a good plan to raise the stack sufficiently high on dunnage to admit cats under the stack. Spaces so made also render the fumigation of the under side of the stack, to kill rats, a comparatively simple matter. (See Appendix C.)

Experimental insulation of a whole stack has not yet been attempted, but it is hoped that an opportunity will occur. Meanwhile farmers who cannot store in bulk are urged to adopt on trial some means of stack insulation best suited to their local conditions. As in all maize storage, the grain must, of course, be dry. The minimum size of a stack in which insulation is likely to be effective is not known.

(*To be concluded.*)

The Tobacco Aphid

By Rupert W. Jack, Chief Entomologist.

In 1928, when the present writer contributed an article to the *Rhodesia Agricultural Journal* entitled "Tobacco Pests of Rhodesia," no species of aphid, or "green fly," had been reported as a serious pest of tobacco in this Colony.

Since that time the species which is the subject of this review, namely, *Myzus persicae,* Sulz., locally known as "Tobacco Aphis," has not only appeared as a destructive pest of this crop, but has increased progressively in importance. At the present day it is considered by some growers to be a definite menace to the future of the industry. It came to notice in the first place as a pest of Turkish tobacco late in the season, but of recent years has attacked Virginia tobacco throughout the growing season, even as early as December. It appears to be becoming more generally prevalent as a tobacco pest year by year and the severity of its attacks appears to be increasing.

The pest has not been closely studied in Southern Rhodesia, but owing to its increasing ravages it is hoped that suitable arrangements will be made in the near future for a thorough investigation of its life economy in relation to tobacco and for comprehensive experiments in methods of control.

In the meantime tobacco growers may be interested in a brief survey of the position.

The distribution of *Myzus persicae* is more or less cosmopolitan. It appears to occur throughout the Old World, and was long ago introduced to the United States of America, where it is stated now to be generally distributed, although not attacking tobacco to a serious extent.

This species, however, attacks tobacco in other parts of Africa, including Nyasaland and the Union of South Africa, and also in India, Ceylon, Dutch East Indies, Palestine, Roumania, Russia and, no doubt, other countries.

The number of different food plants recorded is extremely large (see C. K. Brain, *R.A. Journal*, May, 1940). Practically all garden vegetables may serve as hosts, and particularly those of the cabbage family in this Colony. The aphid also occurs on many wild plants and weeds, as well as on ornamental plants and shrubs and some fruit trees. The usual common name for the insect in entomological literature is "The Green Peach Aphid," as it is a major pest of peach trees in the United States of America and also in the Union of South Africa and elsewhere, but this name is unsuitable in reference to attack on tobacco.

Aphids are sucking insects, extracting the plant juices from the tissues of their host plants by means of their slender beaks. Heavy infestation on growing plants may cause debility and retardation of growth, and the leaves may be depreciated in quality by the extraction of a considerable portion of their contents. Heavily infested leaves sometimes turn brown and dry up on the plants in the field. Moreover, the aphids secrete a sweet liquid, known as honey-dew, which adheres to the surface of the leaves, and in damp weather a black fungus ("Sooty mould") is liable to develop on this liquid and the leaves in such circumstances are, of course, badly disfigured. Leaves covered with honey-dew tend to turn black in the curing barn.

In addition to direct injury, the tobacco aphid is the vector of a serious virus disease, known in the Colony as "Tobacco Rosette." A description of this disease by Dr. J. C. Hopkins, Senior Plant Pathologist, was published in the *R.A. Journal*, January, 1939.

The tobacco aphid, therefore, needs controlling on account of both direct injury to the plant and of the disease which it transmits.

A few words are necessary concerning the way in which the aphid breeds. In warm countries breeding appears to be entirely asexual and males are apparently not produced under South African conditions. The females do not lay eggs but give birth to young aphids one at a time, under favourable conditions at the rate of several per day. The young aphids grow and moult their skins several times until they become adult. The rate of development has not been ascertained in Southern Rhodesia, but it depends considerably upon the temperature and other factors. At Rustenberg in the Union of South Africa the period occupied in development from birth to the adult stage is stated to be 2-3 weeks (Smith, 1937). The female is stated by the above author to produce from 50 to 100 young in the course of her life, which lasts about three or four weeks. In the Dutch East Indies, it is recorded that where the maximum temperature is not above 84.2° F., the average number of young is approximately 50 and the average life of the parent is 15-16 days (Kuijper, 1929). The young are stated to mature and commence producing in seven days at a mean temperature of about 77° F. (*e.g.*, de Jong, 1929). It is owing to this rapid development that the rate of increase of aphids is so great.

Mature female aphids occur in two forms, namely, winged and wingless. It is through the winged form that migration to fresh plants is normally effected.

The factors favouring the increase of this pest appear to be complex. In Java it is stated to be prevalent "in all dry years" (Meded. Besoekisch. Proeft. Nov., 1939). In Russia it is stated in one report to have been checked by heavy rains (Ustinov, 1932). In Nyasaland in the 1929-30 season the pest was considered to have been favoured by a dry spell following the early rains, but in the annual report of the Department of Agriculture for 1933 it is stated to have been "unusually abundant on tobacco during the past few seasons" (Smee, 1930 and 1933). In the British Isles high humidities are stated to discourage the migratory flights of the winged females (Davies, 1935). In Southern Rhodesia the past two seasons have been noteworthy for exceptionally heavy rains, but the pest has been increasingly prevalent even during the wet season; in fact, the variation in the seasons experienced during the past ten years does not seem to have affected the pest to any great extent. The effect of humidity and rain obviously calls for closer study.

With reference to temperature, high temperatures are stated to check reproduction and a mean of 77° F. is recorded as about the optimum for breeding of this species (de Jong, 1929). This mean is considerably higher than the mean temperatures during the growing season in the main tobacco growing areas of this Colony. In India it has been stated that this aphid can multiply rapidly at temperatures lower than those necessary for the reproduction of its natural enemies (Misra, 1932), in which case relatively low temperatures may favour increase.

The parasites of the tobacco aphid in the Colony include certain minute wasp-like insects of the genus *Lysiphlebus* (*Aphidius*) which lay eggs in the aphids by means of their sharp ovipositors (see fig. 7). The grub which hatches from such an inserted egg devours the substance of the aphid, finally causing its death, and when full grown changes to the pupa stage within the aphid's skin. The tiny wasp emerges later through a neat circular hole. The grower can recognise the work of these parasites by the presence of numbers of swollen dry dead aphids which are light brown in colour, and by the holes cut through the skin of many of them by the escaping adult parasites.

This parasite appears to be one of the most important enemies of aphids in the Colony, especially during the winter when a very high rate of parasitisation has been recorded, for instance in the cabbage aphid. In fact, the parasite can apparently keep this pest under control in the cold months, but seems to be less effective in warmer weather.

Amongst the more important enemies of aphids are certain species of ladybirds which, both as adult beetles and as grubs, devour the insects on the leaves. A common form* is black and red or yellow in the adult stage (see fig. 1), and black with yellow markings as a grub (see fig. 2), but there are several other species with similar habits (see figs. 3 and 4).

Certain species of so-called "hover flies" are also responsible for much destruction of aphids. A common species† is banded with black and yellow on the abdomen and is about half an inch in length (see fig. 5). These flies have

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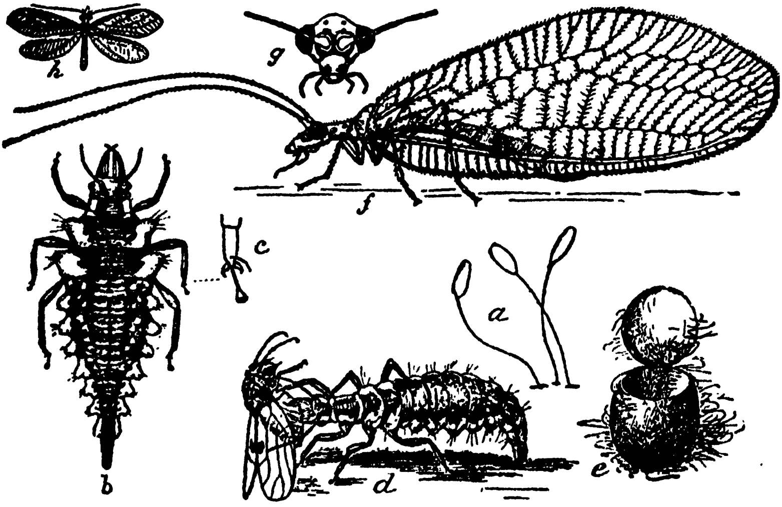
***Chilomenes lunata*, F. †*Ischiodon aegyptium*, Wied.

the habit of hovering in the air, motionless except for their rapidly vibrating wings, and then darting off for a short distance and repeating the performance. The flies feed on nectar and pollen and are not directly beneficial. They lay their eggs, however, amongst aphid colonies, and from these eggs hatch the larvae (maggots), which are rather slug-like and of a greenish or brownish colour. The larvae live amongst the aphids and seize individual after individual, raising them in the air, sucking the juices from their bodies and discarding the empty skins (see fig. 6). They have been observed to consume aphids at the rate of one a minute over a considerable period.

The so-called "aphid lions" are the young (larvaé) of "lacewing flies." The adults are delicate insects with large gauzy wings and metallic coloured eyes, and are sometimes called "golden eyes." Their eggs are attached by stalks to the surface of the leaf. The young are active creatures, superficially resembling ladybird grubs, and move about rapidly, seizing aphids and sucking their contents.



An aphid lion or lace-winged fly: a, several eggs showing the long pedicals that elevate them; b, larva dorsal view; d, larva feeding on a plant louse; e, empty cocoon showing lid through which the adult has escaped; f, adult side view; 8, head of an adult from in front. (From Marlatt, U.S.D.A.)

The question of utilising the parasites and natural enemies of the tobacco aphid for the purpose of keeping the pest under control has exercised the minds of certain tobacco growers. There is, however, considerable misconception concerning the practicability of such an undertaking.

Aphids are attacked by a wide variety of enemies in this Colony, as elsewhere, and it is obvious that these enemies do not in general keep the tobacco aphid and other aphid pests suppressed. Moreover, their efficiency in this respect does not increase as the season progresses. To enable these enemies to suppress the aphid it has been suggested that the Department should breed them in vast numbers for release in the field. There are, however, serious technical difficulties in the way of breeding large numbers of such insects in confinement, and it is doubtful if certain kinds can be bred at all under artificial conditions. Ladybirds can be bred readily, but the problem of providing food for the feeding of vast numbers of these insects presents considerable difficulties.

Leaving these difficulties out of consideration, the prospect of success from artificial propagation of an obviously ineffective enemy of a pest is very remote. There is, to the writer's knowledge, no record of successful utilisation of natural enemies to control a pest except in circumstances where the enemy is naturally capable of suppressing its host during the growing season of the crop concerned. This is obviously not the case in this instance.

The following example of an attempt to utilise a native species of ladybird against aphids in the United States of America may be cited to illustrate the pitfalls in the way of attempts of this nature. In this case the difficulty of breeding the ladybirds in large numbers did not enter into the problem and the chances of practical success were thereby greatly increased. The information is taken from Professor H. L. Sweetman's book, "The Biological Control of Insects."

The species of ladybird concerned* feeds on aphids and is generally distributed throughout the area of the experiment in California, very much as the common species shown at

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Hippodamia convergens, Guer.

fig. 1 is in Southern Rhodesia, but it is ineffective in controlling the abundance of aphids on market garden produce. It was estimated that an increase of about 30,000 individuals per acre might give the desired result. This ladybird hibernates in vast numbers in the Sierra Nevada Mountains, and, before the snows melted each year, enormous quantities were collected and transferred to a storage plant in Sacramento, where they were kept at a suitable temperature until required.

On reports being received from growers concerning aphid outbreaks, shipments of the ladybirds were made to the localities concerned, where they were liberated. In this way upwards of 75,000,000 ladybirds have been distributed amongst growers in a single season. These experiments were continued for seven years before the subject was given scientific study as to its value as a commercial undertaking. The United States Bureau of Entomology finally investigated the position and found that, after release, the ladybirds scattered so rapidly over large areas that they were of little value as far as controlling local aphid outbreaks was concerned. The distribution of these ladybirds has therefore been discontinued.

There are, however, circumstances under which the efficiency of natural enemies can be artificially increased. The most noteworthy instance refers to enemies which are otherwise capable of controlling species of aphids, scale insects, mealy bugs, etc., but are prevented from doing so by the protective activities of certain species of ants. The ants attend the pests on account of the sweet honey-dew secreted by the latter, and destroy large numbers of enemies, *e.g.*, ladybird larvae, which would otherwise reduce the pests to negligible numbers. In the case of mealy bugs attacking coffee trees in Kenya, and also citrus trees in the Union of South Africa, benefit has resulted from encircling the trunks of the trees with bands of various kinds which prevent the ascent of the ants. The natural enemies, having free scope under these conditions, have been able to keep the pests from undue increase. Such methods are, of course, not applicable to tobacco.

It is sometimes possible to increase the efficiency of natural enemies in circumstances under which these enemies are capable of controlling a pest as the growing season progresses, but are only present in very small numbers at the commencement of the season, due to unfavourable conditions during the winter. In such circumstances a pest may increase greatly and do a great deal of harm before its enemies obtain the upper hand later in the season, and if large numbers of enemies can be released early in the season the pest may be brought under control much earlier. This, however, is not the picture in the case of the tobacco aphid in this Colony.

Parasitic and predatory enemies call for careful study in relation to the tobacco aphid problem, but the prospect of keeping the pest under control on an economic basis by utilisation of such agencies is, in the circumstances, very small.

THE DIFFICULTIES AND PROSPECTS OF CHEMICAL CONTROL.

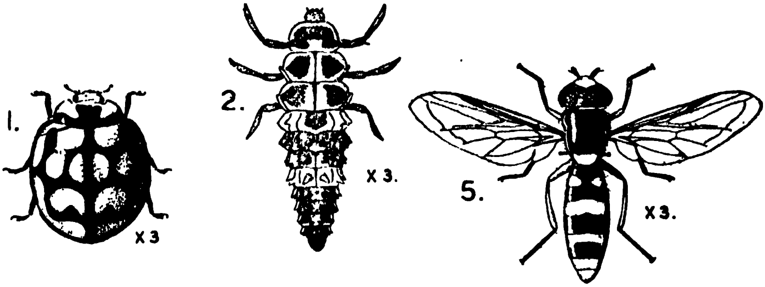
Most aphids are amongst the easiest of insects to kill with contact insecticides. The sprays or dusts used for this purpose usually contain nicotine or derris (rotenone), although aphids are killed on contact by many other preparations. The difficulty is to hit and kill practically all the aphids, and so to prevent the plants from becoming seriously infested again within a short period, due to the high rate of increase of these pests.

Most of the attempts by growers to control the pest in this Colony appear to have been made when the crop has become more or less grossly infested in the field, and in the case of Turwish tobacco when the leaf has been nearing maturity. There are obvious difficulties in the way of thorough spraying or dusting of advanced tobacco plants in the field. There is too much overlapping foliage to contend with. It would seem, in fact, that unless measures taken earlier during the growth of the crop prove to be effective in minimising infestation when the plants are nearing maturity, the problem of protecting tobacco crops from the attack of this pest will prove to be very difficult of solution.

In other countries primary emphasis is laid upon keeping the seed-beds as free from infestation as is possible. In the general way the seed-beds should be made in open airy situations, and it is probably good practice, where possible, to burn off the veld for some distance around the beds shortly after sowing. The beds should on no account be made close to the kitchen garden, as most plants grown for table vegetables serve as hosts for the aphid. The beds should be properly constructed and the covers should be made in one piece and be kept insect-proof. Aphids tend to invade the beds in the winged form and can be kept out to a large extent by careful attention to the adjustment and weighting down of sound covers.

After the plants have started to grow freely they can be sprayed once a week with, say, a nicotine or tobacco extract, diluted according to the manufacturers' directions. A 40% nicotine sulphate extract can, for instance, be diluted with 800 times its bulk of water, but there are much weaker extracts on the market which need to be diluted proportionately. One pound of soap should be dissolved in hot water and added to each 20 gallons of the diluted spray fluid. This is important, as nicotine is more effective as a wash if soap is added, even apart from the fact that the soap increases the wetting power of the spray. Nicotine preparations, *without soap*, can be combined with the Bordeaux and lead arsenate wash, which is at present in more or less general use, but there are certain points to be considered in this connection. The nicotine spray needs to be applied with more force than is either necessary or altogether desirable in the case of the Bordeaux-lead arsenate wash, and in a somewhat different manner. As the aphids occur mostly on the undersides of the leaves, the nicotine spray must be directed in such a way as to turn the leaves of the young plants back from all directions as far as possible, so that the spray wets the under surfaces. A fine spray directed over the upper surfaces of the leaves will be of very little use against the pest. At the same time, the saving of labour in applying a spray which serves three purposes may be considered sufficient to outweigh the disadvantages indicated.

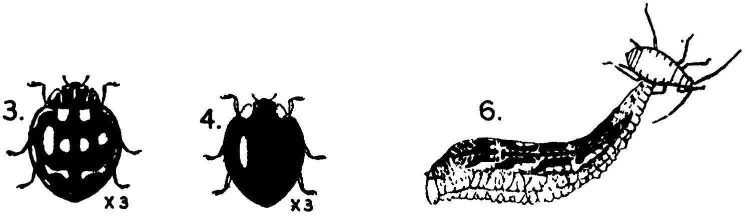
Nicotine dusts have also been recommended for the treatment of seed-beds.



Chilomenes lunata, F.
Adult.

Chilomenes lunata, F.
Larva

A HOVER FLY.
Ischiodon aegyptium, Wied.



Adalia intermedia, Crotch.

Exochomus auritus, Serv.

A hover fly larva feeding on an aphid.
(after C.R.Jones.).

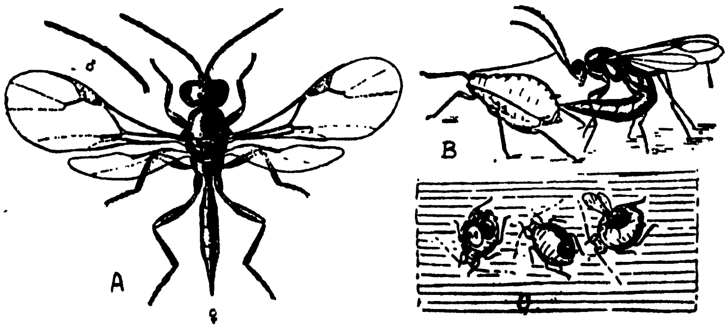


Fig. 7

Derris (rotenone) preparations are excellent against aphids and can be used in place of nicotine, either as sprays or dusts. They are also cheaper than nicotine under normal conditions.

The most detailed directions available concerning treatment of the crop in the field have been given by Mr. A. J. Smith, Entomologist at Rustenburg, in the Union of South Africa. Mr. Smith (1937) advises that the plants should be primed to a height of about 6 inches from the soil when they are about one foot high. The primings, which are very liable to bear aphids, should be thrown open in such a way that the insects are killed by the sun. Otherwise they might be thrown into suitable receptacles and removed from the land for addition to the compost heap. The land should now be carefully inspected for infested patches and, if found, these should be treated immediately by either spraying or dusting. Dusting with a 2% nicotine dust is specially recommended if the infestation is at all general. The quantity of dust required per acre is stated to be 25 lbs-50 lbs. Knapsack dusters of the "bellows" type are recommended for applying the dust.

It may be remarked that, according to certain prominent growers in this Colony, nicotine dust cannot safely be applied to tobacco after a certain stage of growth because the mineral carrier sticks so closely to the gummy surface of the leaves that it persists after curing as a whitish deposit, to which the manufacturers object.

The above recommendations apply to the Virginia tobacco only and obviously constitute sound advice. Pending the results of further experience and investigations in the Colony they may be commended to the consideration of tobacco growers.

It remains to be ascertained, however, whether proper attention to the seed-beds followed by the suggested measures in the field will prevent the almost total infestation of maturing crops, which has recently been seen in the Colony, and especially whether infestation of the Turkish crop late in the season can be thus avoided.

This depends, of course, upon the cause of these general infestations. They might be due to increase and dispersion of aphids from centres created by the planting out of infested seedlings, but on the other hand they might be due to invasion of the growing crop by winged females from natural hosts occurring in the veld. This point is of the greatest importance and will need to be thoroughly investigated.

Presuming that the veld were found to constitute a menace in the above respect it would appear that benefit should result from preserving the grass around the lands until close to the planting season and then burning it off over a considerable width, thus destroying any aphids which may be present on natural host plants amongst the grass.

A few words are necessary concerning methods of spraying and spray machinery. Several farmers have reported unsatisfactory results from spraying even relatively young Virginia crops against aphid. As standard extracts were used in these cases the failures were presumably due to imperfect spraying, which again might be due to imperfect methods or unsuitable machinery, or to both combined. Neglect of primary priming would, of course, tend to lessen the effectiveness of the measure.

Again, spraying is something of an art, and needs to be carried out with a knowledge of the exact object in view and with a reasonable amount of intelligence. As the aphid occurs mainly on the undersides of the leaves the aim must be to wet the under surfaces as thoroughly as possible, whilst not neglecting the growing shoots, which are also much infested. For this purpose it is necessary that the nozzle be attached to a short extension rod and be fixed at or adjustable to an angle with the rod, a full right angle being probably the best setting. This enables the operator to spray the under surfaces of the leaves easily and effectively. A similar arrangement of the nozzle is also desirable for spraying seed-beds against aphids.

Lever operated low pressure knapsack sprayers, which are in common use for spraying tobacco with Bordeaux mixture against diseases, are less suitable for spraying against aphids. A relatively high pressure improves the wetting power of the spray and is desirable in the case of these insects.

It is unfortunate that, with the quality of labour available in the Colony, the use of animal drawn field sprayers is questionably practicable, even in the case of relatively young crops, and is certainly not practicable after the crop has attained a certain stage of growth. With such machines better spraying could be carried out. If knapsack sprayers have to be used the pneumatic types, which work at a pressure of up to 100 lbs. or more, may prove to be the most suitable, but this is a point which remains to be determined.

Fair working pressures can also be obtained with lever operated hand pumps fixed to small tanks, which are mounted like a wheelbarrow for portability. There should be no objection to taking these machines through the rows before the tobacco attains too much growth. Small power sprayers, similarly mounted, are also manufactured.

Dusting may prove to be rather more effective than spraying against the tobacco aphid; in fact, nicotine dusts are more or less generally preferred to nicotine sprays against aphids on vegetable and other low growing crops.

It requires to be ascertained therefore up to what stage of growth dusts can safely be applied to the tobacco crop. The reported difficulty concerning the dust residue adhering to the leaves, which has been mentioned, is rather curious in face of the fact that arsenical dusts are largely used in America for control of tobacco "hornworms" and other leaf-eating insects, and are not infrequently applied to the plants quite late in the season, *e.g.*, up to the early part of August. It would seem that the matter of dust residue would bear careful investigation.

Dusting can be carried out much more quickly than spraying. It also requires less labour and, of course, does away with the necessity of hauling water. On the other hand the expenditure on material per acre at Rhodesian prices would be greater for nicotine dust than for nicotine spray. Taking the respective quantities of material required per acre as 30 lbs. dust or 100 gallons diluted spray, the price of these quantities would be about 30s. for the dust and about 10s. for the spray, including 5 lbs. of soap.

It is to be hoped in any case that the whole problem will receive careful study in the near future, and that it will be possible at a later date to give detailed advice, based on reliable data, concerning the most effective and economical methods of dealing with the pest.

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EXPLANATION OF PLATE.

Fig. 1.—Adult of the common ladybird, *Chilomenes lunata*, F., which feeds on aphids. Colour black and yellow or black and light red.

Fig. 2.—Larva of above, which also feeds on aphids. Colour black and yellow or white.

Fig. 3.—Adult of an aphid-eating ladybird, *Adalia intermedia*, Crotch. Colour black and yellow.

Fig. 4.—Adult of an aphid-eating ladybird, *Exochomus auritus*, Serv. Colour black with yellow spots on thorax.

Fig. 5.—Adult of common *Syrphid* fly, *Ischiodon aegyptium*, *Wied*. Colour dark green, black and yellow.

Fig. 6.—Larva of *Syrphid* fly, species not stated, feeding on an aphid (after C. R. Jones, slightly adapted).

Fig. 7.—The common aphid parasite, *Aphidius testaceipes*, Cres., which is a highly important enemy of aphids (after Webster).

Rhodesia Weather Bureau.

JUNE, 1940.

PRECIPITATION.

Station.	Inches.	Normal.	No. of days
Beitbridge	1.50	0.02	2
Bindura	Nil	0.06	—
Bulawayo	1.27	0.03	3
Chipinga	0.60	0.66	7
Enkeldoorn	0.89	0.07	5
Fort Victoria	0.95	0.09	5
Gwaai Siding	0.14	Nil	3
Gwanda	2.57	0.06	5
Gwelo	1.48	0.02	7
Hartley	0.28	0.01	3
Inyanga	0.02	0.12	2
Marandellas	0.38	0.09	5
Miami	0.01	0.12	1
Mount Darwin	Nil	0.04	—
Mount Nuza	0.54	2.48	9
Mtoko	Nil	0.06	—
New Year's Gift	0.41	0.41	7
Nuanetsi	1.25	0.08	2
Plumtree	1.78	Nil	1
Que Que	1.26	0.01	3
Rusape	0.41	0.29	3
Salisbury	0.30	0.06	4
Shabani	0.57	0.16	3
Sinoia	0.57	0.02	3
Sipolilo	Nil	0.04	—
Stapleford	0.69	1.21	8

Station	Inches.	Normal.	No. of days.
Umtali	0.15	0.26	4
Victoria Falls	0.21	0.01	2
Wankie	0.16	Nil	2
Broken Hill	0.15	—	1
Fort Jameson	Nil	—	—
Isoka	Nil	—	—
Kalomo	0.83	—	4
Kapiri Mposhi	Nil	—	—
Kasama	Nil	—	—
Kasempa	0.20	—	1
Luangwa	Nil	—	—
Livingstone	0.28	—	2
Lundazi	Nil	—	—
Lusaka	0.03	—	1
Mankoya	Nil	—	—
Mazabuka	0.03	—	1
Mkushi	Nil	—	—
Mongu	0.03		1
Mufulira	Nil	—	—
Mumbwa	Nil	—	—
Mwinilungu	Nil	—	—
Namwala	0.08	—	1
Ndola	Nil	—	—
Solwesi	0.31	—	1

JUNE, 1940

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F.														PRESSURE MBS.			Cloud Tenths.	Sunshine hours.
		8.30 a.m.							Absolute.		No. of Days.									
		Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min. ÷ 2.	Maximum. Date.	Minimum. Date.	Max. > 85°	Max. < 70°	Min > 65°	Min. < 40°	Mean of 24 hrs.	8.30 a.m. Station Level.	8.30 a.m 1200 gdm.	Mean of 24 hrs.		
Beitbridge	1486	60.6	55.0	51	5.5	76.9	49.4	63.2	89:12	39:29	2	3	—	1	62.5	971.3	887.5	969.5	2.8	—
Bindura	3700	58.3	52.8	48	5.2	73.5	46.7	60.1	81:12	36:30	—	4	—	4	—	—	—	—	2.5	—
Bulawayo	4393	54.9	49.9	45	4.4	69.3	45.1	57.2	81:12	37:20	—	18	—	6	56.1	874.3	886.0	873.2	3.9	8.5
Chipinga...	3685	58.7	54.2	51	4.4	67.9	50.7	59.3	81:12	45:v.	—	17	—	—	—	897.6	896.7	—	3.9	—
Enkeldoorn...	4808	55.1	50.6	47	4.0	68.4	45.8	57.1	79:11	35:27	—	18	—	6	—	861.6	885.7	—	3.5	—
Fort Victoria	3571	56.4	52.2	48	4.0	70.0	45.4	57.1	82:12	35:28	—	17	—	6	57.1	901.7	887.2	—	4.1	—
Gwanda...	3233	54.8	50.7	47	3.7	70.6	46.0	58.3	85:13	36:29	—	16	—	6	57.9	912.0	886.4	910.7	4.0	—
Gwelo	4629	54.6	50.5	46	4.2	68.2	45.2	56.8	79:11	34:27	—	18	—	5	56.0	866.9	885.9	—	4.0	—
Hartley	3879	56.5	51.5	47	4.6	73.4	44.6	59.0	83:11	33:30	—	7	—	6	58.3	890.4	885.8	—	2.5	—
Inyanga	5503	56.8	51.6	47	4.8	66.7	44.5	55.6	75:11	30:29	—	19	—	5	—	—	—	—	3.0	—
Marandellas	5453	54.1	48.8	44	4.7	65.5	44.8	55.2	77:12	37:v.	—	17	—	6	—	—	—	—	4.4	—
Miami	4090	59.0	53.6	49	5.2	71.9	47.8	59.9	80:12	41:27	—	10	—	—	58.1	882.8	884.8	881.3	2.6	—
Mt. Darwin...	3179	59.8	54.6	51	5.2	75.4	46.6	61.0	83:20	40:v.	—	1	—	—	—	—	—	—	2.4	—
Mount Nuza	6668	48.5	45.5	43	2.4	55.9	44.2	50.1	68:15	37:24	—	30	—	8	48.9	805.0	886.1	—	5.3	—
Mtoko...	4136	59.3	53.4	48	5.7	70.2	50.5	60.3	79:12	43:26	—	15	—	—	59.6	882.4	886.0	881.3	2.8	—
New Year's Gift ...	2690	56.2	53.9	52	2.2	72.6	48.7	60.7	85:12	39:30	—	12	—	1	—	—	—	—	—	6.3
Nuanetsi	1547	57.9	55.3	54	2.4	76.4	44.5	60.5	90:12	38:23	2	4	—	4	—	967.8	886.6	—	2.7	—
Que Que...	3999	56.3	51.6	48	4.3	72.3	46.2	59.3	82:11	38:v.	—	11	—	5	58.7	886.7	885.9	885.4	3.1	—
Rusape	4648	55.4	51.2	48	3.8	67.9	45.0	56.5	78:12	33:30	—	17	—	8	55.5	—	—	—	4.4	—
Salisbury	4831	56.2	51.1	47	4.7	70.0	45.4	57.7	79:11	35:25	—	14	—	7	56.4	860.5	885.7	859.4	3.6	8.1
Sinoia	3795	57.1	52.4	48	4.3	75.0	42.6	58.8	83:12	32:30	—	2	—	7	—	—	—	—	2.6	—

JUNE, 1940 (continued)

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F.														PRESSURE MBS.			Cloud Tenths.	Sunshine hours.
		8.30 a.m.							Absolute.		No. of Days.									
		Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min.÷2.	Maximum Date.	Minimum Date.	Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hrs.	8.30 a.m. Station Level.	8.30 a.m 1200 gdm.	Mean of 24 hrs.		
Stapleford	5304	51.6	49.2	47	2.1	61.8	39.5	50.7	74:12	26:30	—	27	—	15	—	—	—	—	4.4	—
Umtali	3672	57.2	53.9	52	3.0	71.1	49.9	60.5	82:12	41:27	—	13	—	—	59.0	897.9	886.7	896.9	3.5	7.1
Wankie	2569	55.8	51.8	48	3.7	78.7	51.6	65.1	88:13	44:v.	2	1	—	—	—	933.3	886.1	—	2.5	—
Abercorn	5458	62.1	54.9	49	7.2	77.3	51.2	64.3	83:20	46:v.	—	1	—	—	62.5	840.4	883.7	—	1.6	—
Broken Hill	3911	59.4	54.0	50	5.2	73.3	49.5	61.4	84:18	38:29	—	10	—	1	60.4	888.5	884.7	—	4.0	—
Fort Jameson... ...	3815	64.0	56.4	51	7.8	75.5	55.2	65.4	83:20	47:29	—	4	—	—	64.2	892.6	886.1	891.2	1.7	8.0
Fort Roseberry ...	3830	62.2	56.5	53	6.7	76.9	47.2	62.0	85:18	38:27	—	1	—	5	60.9	—	—	—	—	—
Kasama	—	60.8	55.7	52	5.0	76.1	51.1	63.6	82:v.	41:27	—	3	—	—	63.3	867.6	884.4	—	2.2	10.5
Kasempa...	4500	52.2	49.9	48	1.9	76.0	43.4	59.7	84:16	35:31	—	2	—	5	—	—	—	—	—	—
Livingstone...	3051	55.7	52.0	49	3.3	75.6	45.7	60.6	87:12	37:28	2	1	—	6	59.8	913.3	885.0	911.8	2.4	9.0
Luangwa Bridge ...	1330	63.2	58.1	55	5.4	83.6	55.9	69.7	91:13	46:27	12	—	2	—	69.0	—	—	—	—	—
Lundazi	3590	63.6	58.8	56	5.1	77.1	44.9	61.0	84:17	30:30	—	1	—	1	60.4	—	—	—	—	—
Lusaka	4193	60.0	53.7	49	6.2	72.4	51.0	61.7	80:12	43:30	—	—	—	—	59.7	879.2	884.5	878.0	3.4	9.2
Mongu	3481	59.5	52.9	48	6.3	78.3	52.0	65.2	87:13	43:28	2	—	—	—	64.7	901.3	883.9	—	1.7	9.7
Mpika	4620	61.2	56.8	54	4.6	71.8	49.4	60.6	80:19	41:29	—	12	—	—	59.1	866.2	885.5	—	2.7	—
Msoro	3000	63.6	57.9	54	6.1	82.8	50.5	66.7	90:18	42:26	13	—	—	—	65.4	—	—	—	—	—
Mumbwa...	3500	57.9	53.2	50	4.3	75.6	41.8	58.7	83:13	32:27	—	4	—	11	57.5	—	—	—	—	—
Mwinilunga...	4450	55.3	52.0	49	2.9	78.6	44.6	61.6	94:1	40:v.	2	—	—	—	—	—	—	—	—	—
Ndola	4190	58.0	53.4	50	4.4	76.6	47.2	61.9	83:17	38:30	—	3*	—	3	61.4	879.4	884.4	—	1.6	8.9
Chileka	2600	66.7	59.5	54	7.8	75.0	56.8	65.9	83:17	52:26	—	6	—	—	64.8	933.4	886.7	—	4.6	—

Southern Rhodesia Veterinary Report.

JUNE, 1940.

DISEASES.

African Coast Fever was diagnosed on farm Wheelerdale in the Salisbury native district.

TUBERCULIN TEST.

Six bulls and sixty-seven cows and heifers were tested on importation, of these four cows reacted, and were destroyed. Three cows gave a positive reaction to a re-test and these were destroyed.

MALLEIN TEST.

One horse was tested with negative results.

IMPORTATIONS.

From Union of South Africa: Bulls 7, cows and heifers 67, horses 1, pigs 16, sheep 767.

From Bechuanaland Protectorate: Slaughter cattle 1,144, sheep and goats 604.

EXPORTATIONS.

To Northern Rhodesia: Sheep 147.

To Portuguese East Africa: Slaughter cattle 120.

To Belgian Congo: Donkeys 15.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

To United Kingdom: Beef quarters (chilled quality), 10,308; boneless beef quarters, 2,088; tongues, 19,759 lbs.;

livers, 51,378 lbs.; hearts, 14,439 lbs.; tails, 9,595 lbs.; skirts, 16,797 lbs.; shanks, 4,876 lbs.; kidneys, 3,361 lbs.; fat, 541 lbs.; cheeks, 4,365 lbs.; fillets, 3,353 lbs.

To Northern Rhodesia: Beef carcases, 31; offal 3,104 lbs.

To Belgian Congo: Beef carcases, 61; mutton carcases, 12; offal 72 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa: Corned beef, 181,444lbs.; beef fat, 500 lbs.; beef paste, 2,224 lbs.; sausages, 3,408 lbs.

B. A. Myhill,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-40.

Monthly Report No. 92. July, 1940.

Red Locusts (*Nomadacris septemfasciata*, Serv.).

Reports received during July refer to four winged swarms only, the districts involved being Lomagundi, Mazoe, Insiza and Melsetter.

Two of the swarms were described as "large" and two as "medium."

The paucity of the reports may be due to inactivity on the part of the insects on account of the cold weather.

Rupert W. Jack,
Chief Entomologist.

THE RHODESIA
Agricultural Journal

Vol. XXXVII.] No. 9 [September, 1940

Editorial

Notes and Comments

THE HON. J. W. DOWNIE.

The Hon. John Wallace Downie, C.M.G., died in the Salisbury General Hospital on the morning of August 22nd, 1940, and there passed from our midst a man who for many years had laboured earnestly for the advancement of the Colony—one whose honesty of purpose had won widespread respect amongst all sections of the population.

Mr. Downie's close contact with the agricultural industry commenced about 1920 when he first associated himself with the Farmers' Co-op. Society, Salisbury, and the Rhodesia Farmers' Co-op. Industries, Ltd., of which he was general manager from 1920 to 1924. The present pre-eminent position of the first named Society in the farming life of Mashonaland is largely attributable to the sound foundations of the business which he so well and wisely laid.

Mr. Downie's entry into public life coincided with the Colony's movement to secure Responsible Government, in the cause of which he was an ardent champion. He entered the first Rhodesian Parliament as co-member for the Mazoe constituency with Sir Francis Newton, K.C.M.G., whom he later succeeded as Colonial Secretary when Sir Francis was transferred to London as Southern Rhodesia's first High Commissioner in the United Kingdom. After holding the office of Colonial Secretary for only a short time Mr. Downie exchanged portfolios with Mr. W. M. Leggate, C.M.G., and in February, 1925, became Minister of Agriculture and Lands.

He held this office for two and a half years during a period when, as the Colony settled into her stride under Responsible Government, numerous changes in our agricultural and land settlement policy became possible and were introduced. Finally, in the Moffat Ministry, he accepted the portfolio of Minister of Mines and Public Works until he proceeded to London as High Commissioner, from 1930 to 1934, in succession to Sir Francis Newton. In this responsible office Mr. Downie's keen grip of business affairs led him to become, in addition to his other duties, a most energetic Trade Commissioner. In this direction he rendered inestimable service to the Colony and to his efforts were largely due the gradually increasing interest in Southern Rhodesian flue-cured tobacco in the United Kingdom and the initial steps which ultimately resulted in the development of the beef export trade.

Thus passes yet another Rhodesian who in public and private life has served his country well.

The sympathy of all who knew him personally or by repute will be extended to his widow and son and daughter in their bereavement.

POPULAR MISCONCEPTIONS.

Recently at farmers' meetings and elsewhere the possible future shortage of artificial fertilisers has resulted in a spate of suggestions and advice, some well informed, some not so well informed. The two most usual substances mentioned in this connection are lime and compost, and at one meeting it was urged that lime should be applied in place of the more usual artificials, because it was such a good fertiliser. Compost, of course, is continually being publicised and it is well that it should be kept in the forefront. However, much that is said of lime and compost betrays a fundamental misunderstanding, not only of the rôle of these two substances, but also of the soil, and of its relation to fertilisers in general. The soil is not simply a vast inert reservoir into which food substances can be poured and stored until removed by the plant. It is not static. It is dynamic. It teems with fungal and bacterial life and its chemical nature, continually changing, obeys the immutable physical and chemical laws of the universe. Fertilisers added to the soil immediately change their state and combine with the complex portion of the clay, that is the complex molecule composed of iron, silica, and aluminium. It is this fact that makes the application of fertilisers so difficult a problem. In some soils super will combine with iron, in others it will not; and under a certain set of conditions marked acidity may arise in one case but not in another. But there are certain effects of certain causes common to all soils, just as there are common laws.

The three main food elements removed from the soil by cropping are potash, phosphate and nitrogen, the common ingredients of all fertiliser mixture, and no application of lime can make up for their absence. Lime is a plant food to only a limited extent, and its main function in the plant is to combine with the harmful acids, such as formic and oxalic, produced as bye-products of metabolism. It is not a plant food to the extent the others are, but its presence in the soil is essential. In the soil it helps to keep the aluminium-iron-silica complex saturated, and by so doing guards against acidity and the disruption of the clay molecule. A soil saturated with lime flocculates and has a crumb structure which is resistant to erosion, and its mildly alkaline nature makes it an ideal medium for the beneficial soil bacteria. With lime and organic matter a soil can be kept in good tilth and good heart: it will not deteriorate, but unless it is well supplied with nitrogen, phosphate and potash it will not go on producing good crops.

The importance of compost lies in the fact that organic matter in the soil is equally vital. Under natural conditions, forest, bush or veld, all that arose from the soil returned to the soil sooner or later. It was a continuous process of growth, decay, incorporation in the soil and growth again, with the loss of no constituent but nitrogen which was recaptured from the air by the leguminous plants. Under civilised conditions the greater part of what the soil produces is removed and does not return to the soil. So artificials have to be added, and organic matter. Neither is sufficient alone, unless the organic matter can be added in huge quantities. Modern research has shown that just as there are vitamins for animals so for plants there are essential substances affecting quality, which occur only in organic manures. But apart from these, organic matter in the soil improves the tilth and makes possible the existence of the multitudinous soil bacteria upon whose life ultimately depends the life of man.

Elsewhere in this issue is a review of "An Agricultural Testament" by Sir Albert Howard, which deals exhaustively with humus in the soil.

LIVE FENCES.

Live wire fences, samples of which have been exhibited at Rhodesian Shows, have found considerable favour in America, where farmers have shown remarkable ingenuity in adapting the idea to a variety of uses. American research workers who recently made a study of the relation of electricity to agriculture found that not only are farmers using this cheap fencing for confining stock, but they are adjusting their equipment to keep pigs from rooting under ordinary woven wire fences; to prevent vicious horses or bulls from breaking down their stalls (an electrically charged wire running round the inside of the stall was sufficient); to train horses or cows to keep away from barbed-wire fences, eliminating wire cuts; to keep stock from running off a scale platform while being weighed; to fence ditches, dongas and odd corners cheaply and quickly; to keep dogs and other animals away from fowl houses at night; and to break stock from jumping fences by attaching round their necks a short chain which makes contact. It was found possible to break animals from the habit of eating chickens by fastening the shock end of a wire to a dead bird.

The *Queensland Agricultural Journal*, which had collected these data, adds a word of warning against attempting to run these fences from the ordinary electric light wire, an attempt which is likely to result in serious injury or death.

PAWPAW.

An entirely new product for tendering meats of all kinds has just been placed on the market in Great Britain. This is made from the pawpaw fruit, which is rich in enzyme that can in a perfectly natural way combine with meat tissues to make the fibres more tender and to shorten cooking time. The digestive powers of papain are well known to science, and the use of pawpaws for tendering meats has been known to natives for centuries. People in this country have utilised the fruit for this purpose and have cooked meat wrapped in pawpaw leaves with beneficial results. The application of this knowledge on a commercial scale is, however, a new departure.

KITCHEN WASTE.

A recent article in *Nature* indicates powerfully how the war has affected life in Great Britain. A strong measure of planning and scientific application of knowledge have displaced the old *laissez-fare,* and in this respect, particularly as applied to agriculture, the war may be said to have done good. The restrictions in imports have necessitated the cutting down, by two thirds, of the numbers of pigs and poultry; the remainder can not be fed. A search for substitutes for imported feeding stuffs has directed attention to edible kitchen scraps, and the Government and Borough Councils are co-operating in inducing housewifes to retain them. The Ministry of Supply already compels the larger local authorities to rescue metal and paper from domestic refuse; provisions may soon be extended to food waste. Well-equipped factories for the utilisation of fish-waste, which exist throughout Great Britain, can convert any perishable food material into a dry, sterile meal and are now dealing with waste, such as vegetable leaves, potato peelings and other residues, portions of bread and cake and particles of meat and fat. A very rich foodstuff is producea. When combined with other protein-rich materials the town waste makes a meal so highly concentrated that it can be used in the proportion of 1 to 8 of cereals and will go far towards meeting the normal requirements of farm stock.

Although in Rhodesia conditions are very different and facilities for making sterile meals from waste do not largely exist, there yet remains in the towns as on the farms a great deal of unnecessary waste. Any waste on the farm which can be avoided or can be otherwise used is a small but valuable contribution to the economic front.

NITROGEN FIXATION.

In the report of Agriculture and Animal Husbandry in India for 1937-38 it is stated that definite evidence has been accumulated which shows that a cereal crop like maize can fix atmospheric nitrogen under favourable circumstances. There has been a slight significant gain of nitrogen by the soil after a maize crop. The favourable circumstances are not more explicitly defined, and the mechanism ,of the nitrogen fixation is apparently obscure.

TRUCK PARTITIONING FOR PIGS.

The Chief Superintendent of the Rhodesia Railways Ltd. has recently circularised some 600 pigs breeders with regard to partitioned trucks.

The Railway Company has decided to make an experiment with the use of a short livestock truck divided into five compartments for the conveyance of small lots of pigs. The hope is that this will have the effect of eliminating the crating of pigs and, in its place, encouraging some co-operation between neighbouring producers so that by means of an advanced advice by them to the local Station Master or by fixed loading days, a fitted truck can be available when required, thus reducing transport charges.

At the outset there will be two fitted trucks—one at Salisbury and one at Bulawayo.

It is suggested that producers using the same station get together to indicate some idea of their probable requirements. The Railways can then fix a programme of loading days at any station. Alternatively, as pigs cannot always be ready for marketing on fixed dates, each area might elect someone amongst its members to keep in touch with producers using a particular station, so that when five producers are ready a fitted truck could be ordered for the date required. From the Railway Company's angle the latter alternative is preferable.

The capacity of the fitted truck naturally varies according to the size of pigs. It is estimated that the five compartments will hold 6 or 7 baconers each.

The consignments must be despatched in one name to one station and freight must be prepaid. There may be more than one consignee. Each owner should take care that his pigs bear some identifying mark.

MAIZE YIELDS.

Five reminder hints to Union farmers, recently given by the Extension Officer, Lydenburg, for increasing the yields of maize, may perhaps prove of value. They are:—

1. Plant reliable seed, preferably that which you have yourself selected in your lands.
2. Prepare the soil well and give it the necessary application of fertiliser, and if possible a little kraal manure in addition.
3. Cultivate the land before the maize comes up and consequently eradicate weeds before they make their appearance.
4. Control weeds effectively by frequent cultivations. Cultivate deeply at the beginning of the season to conserve moisture, and shallow late in the season so as not to injure the maize roots.
5. Practice a suitable system of rotational cropping.

A New Vegetable:

The Soya Bean

By H. C. ARNOLD.

The soya bean has been described as "unquestionably the most important food plant in the world," because of the high nutritive qualities of its seed, and the multiplicity of ways in which it can be used. Flour prepared from the seed contains from 40% to 45% of good proteins. (Maize meal has 8% and wheat flour 12%.)

It can be used in the place of foodstuffs of animal origin such as meat, milk and eggs. The seed also contains 14% to 20% of oil which can be used for cooking purposes and for the manufacture of margarine. It has been estimated that a pound of soya beans has a nutritive value equal to 2½ lbs. of meat.

This crop has been used in the Orient since ancient times, but until the past half century its great value was not appreciated by Europeans.

The introduction of strains suited to the climatic conditions of Southern Africa has enabled farmers here to cultivate the crop more successfully than heretofore, and the favourable reports on the crops grown in this Colony during the past season indicate that increasingly large areas will be devoted to its cultivation in future.

In view of its nutritive qualities it is thought that it will be found to be a very useful vegetable in many Rhodesian homes. It possesses at least one advantage over other varieties of beans in that it is not subject to attacks by insects, hence the housewife can purchase comparatively large quantities at a time and benefit by the cheaper rates at which such are obtainable. The kinds most suitable for human consumption have light coloured creamy-yellow seeds. Those with dark brown or black seeds are not generally suitable for culinary purposes, although there are a few varieties which are light brown and others of a light green colour which are free from any objectionable flavour. A distinguishing characteristic of cooked soya beans is their texture. Instead of being "mushy" like other beans they have a "nutty" texture and their flavour is reminiscent of chestnuts. Those accustomed to mushy and artificially flavoured beans, may at first consider the plain and unadulterated soya rather tasteless or even unpalatable, but after taking them for a few times a liking for them is acquired. The addition of sugar and lemon improves their flavour in some peoples' estimation, while others find them more acceptable after butter, white sauce, or some other favourite commercial sauce has been applied.

The dry beans should be soaked for at least 3 hours, or preferably overnight, in three cups of water to each cup of beans; drain and cook in sufficient fresh water to well cover all the beans and add salt according to taste. Boiling for 1½ hours is sufficient to cook the beans, but longer cooking softens them and they may be found more acceptable after the boiling has continued for two or three hours. They may be used in soups either cracked or whole and in any of the ways in which other kinds of beans are employed.

Soyas may also be used as a green vegetable. A local grower reported that he had found them to be a more reliable crop than French beans, particularly on land which became somewhat waterlogged owing to unusually heavy rains. Others have found soya beans to be more drought resistant and less liable to insect attack, so on the whole the soya beans are more reliable for summer cultivation than French beans and culinary peas, though the season in which they will be available may be somewhat shorter. This, however, could be lengthened by making successional sowings, and using early and late varieties. They should be sown in rows 2 feet apart and 4 inches to 6 inches in the rows. The beans remain in edible condition for about three weeks. They are ready to use as soon as the seeds reach their full size, and remain usable until the pods turn yellow and the seeds begin to shrink. The most acceptable period lies between the two extremes, and at this stage the pods are green to greenish-yellow. They may be cooked either before or after shelling, but though cooking facilitates shelling, when they are to be served hot it will usually be found most convenient to shell first. This is made easier by pouring boiling water over the pods, and allowing them to soak in it for 5 minutes or so. Then drain off the water and proceed with the shelling. This can be best accomplished by taking the pod in both hands, then keeping both thumbs together, snap the pod across the middle on the opposite side, and simultaneously squeeze the beans into the receptacle placed to receive them. The shelled beans may then be cooked, after adding about one cup of boiling water to a pint of beans with salt to taste. Cover and cook for ten to fifteen minutes after boiling starts. When cooked they have a pleasing bright green colour. Drain and serve with butter, white sauce or in any other manner desired. Avoid over-cooking, because it reduces their nutritive value and spoils the flavour. The green soya beans have a nutty texture, and do not soften like green peas, unless they are much over-cooked.

"In that case a long war would mean an all-Empire tobacco supply which could easily be met, and new habits of smoking for some people which would most likely last after the war, as indeed will many other apparently immutable habits be permanently changed."—S. S. Murray, Nyasaland Representative, London.

A New Head Harness for Oxen.

The illustration opposite shows the use of head harness for oxen on the Mtao Forest Reserve.

This device has been adopted at Mtao for the dragging of logs and poles from the plantations.

Its success may be judged from the fact that two oxen, two drivers and two leaders can do the work of 15 boys.

Nor is this the only advantage, because work of this nature (more especially when dealing with the larger poles) is a great strain on the human frame.

Each ox can comfortably pull a 700 lb. log along the ground.

Each set consists of a shaped metal bar padded like a saddle and fitted with two straps which hold it to the horns. There is no pull on the horns, of course, all the weight being taken by the forehead. To the ends of the metal bar are attached light chains joined by a swingle tree at the back of the ox. The chains are held at a convenient height by a leather belt of hide over the back of the ox, through loops on the end of which the chains are threaded. These two loops which come about half way down the side of the ox should be joined under the belly by a loose reim.

The draught is attached to the swingle tree by a chain. This form of applying the load enables the ox to do a great deal more work with considerably less fatigue. The greater the load the lower he puts his head and the more direct is the pull.

It is an ideal form of draught for small ploughs and cultivators, and if the land is too heavy for one ox they can be driven in tandem, the front ox being equipped with double chains.

SALES

Agricultural Experiment Station, Salisbury.

SPINELESS CACTUS SLABS.

Delivery during September and October	100 slabs	7/6
Delivery during other months .... (not recommended).	100 slabs	12/6

Varieties: Algerian, Muscatel and Nopalea.

KUDZU VINE CROWNS.

Delivery during September, October, January and February...... .... per 100 crowns 15/-

SWEET POTATOES.

Tubers :

Delivery during September and October 7/6 per petrol case.

Cuttings :

Delivery during January and February 6/- per bag.

Varieties: Virovsky, Early Butter, Linslade, Calabash Leaf.

GRASS ROOTS.

Delivery during January and February 6/- per bag

Varieties: Woolly Finger, Swamp Couch, Creeping False Paspalum, Naivasha Star and Panicum. Makarikari in limited quantities only.

Owing to pressure of other duties deliveries cannot be guaranteed during November and December.

All the above will be delivered free by rail to any station or siding in Southern Rhodesia, but the price does not include road motor service charges. Cheques should be made payable to the Department of Agriculture, and preliminary enquiries and subsequent orders should be addressed to the Agriculturist, Department of Agriculture, Salisbury.

NOTICE

Timber Preservation.

The Forestry Division is prepared to consider orders from the public for gumpoles treated with creosote or arsenic.

A period of some months must elapse before treatment to allow for sufficient drying and there is only a small quantity of sufficiently dry timber available at present other than for orders already on hand.

Orders will be dealt with in strict rotation subject to priority for Government requirements.

Prospective purchasers are invited to submit their requirements to the Conservator of Forests, P.O. Box 387, Salisbury, when a price will be quoted and an approximate date for delivery given.

Creosoted poles are suitable for all outside use such as fencing standards, wireless and telephone poles, garden pergolas, etc., and this treatment is recommended for general use.

Arsenical treatment, though cheaper, is less satisfactory and involves considerable danger of stock poisoning.

Poles thus treated can be used for roofing timbers, barn timbers, etc., and in situations where leaching by water and poisoning of stock is not liable to occur.

They may also be used for fencing in situations where stock cannot get at them.

No guarantee is offered as to the life of treated poles, but under average conditions where termites and borers normally cause early failure it is expected that creosote will give a life of five to six times and arsenic about three times that of untreated poles.

H. G. MUNDY,

Secretary,

Department of Agriculture and Lands.

Diseases of Fruit, Flowers and Vegetables in S. Rhodesia.

2.—BLACK ROT DISEASE OF CABBAGES AND CAULIFLOWERS.

By J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A.,
Senior Plant Pathologist.

Black rot of cabbages and cauliflowers is of wide distribution throughout the world, and is also common in this Colony during the rainy season. It was first noted in America in 1889, and has since become distributed in all countries where these vegetables are grown. Not only does the disease attack cabbages and cauliflowers but it is also reported from many other plants of the Cruciferae, as the cabbage family is known botanically. So far, however, its occurrence on such commonly grown plants as radishes and stocks has not been recorded in Southern Rhodesia, but it has recently been reported on turnips. There are many instances of black rot having completely destroyed large plantings of susceptible crops under favourable weather conditions.

Symptoms.—The most noticeable symptoms of the disease in the early stages of infection are yellow blotches, usually on the margins of the leaves. If examined closely, these blotches will be found to consist of thin, parchment-like, fawn-coloured areas, very often " V " shaped, which are surrounded by " halos " of a yellowish-green colour somewhat reminiscent of those caused by wildfire on tobacco. They are illustrated in Fig. 1. Later, these lesions enlarge; the small veins become black and are seen as very fine lines in the parchment-like tissue. As the disease advances, these dead areas extend until the whole leaf may be destroyed and fall from the plant, so that very often only a bare stalk remains surmounted by a badly discoloured head. Under wet conditions putrifying bacteria may gain entrance to what

Black Rot Infection of Cauliflower. Note initial infection of leaf margins.

Black Rot Infection of Cauliflower. Note initial infection of leaf margins.

is left of the plant and the whole be reduced to a soft, evil-smelling mass. In seedlings and young transplants leaf infection may penetrate to the stem, in which case one-sided growth takes place, the plant may become severely stunted and eventually die. If the stalk of an infected plant is cut across, a black ring of discoloured tissue will be seen, the blackening of the woody parts being characteristic of the disease and responsible for the common name of black rot.

Cause.—Black rot is caused by a bacterium (*B. campestre*), which gains entrance to the leaves through minute glands at the edges, from which water is exuded. These glands are known as hydrathodes. If young cabbage plants are examined in the early morning, whilst the humidity of the atmosphere is still high, small drops of water will be observed along the leaf margins. Bacteria present in the soil gain access to these water drops through the agency of rain splash, and as the air becomes drier and normal transpiration in the plant commences, the infected drops of water are drawn into the leaf. The bacteria enter the small veins, where they multiply and advance into the leaf itself. They destroy the veins, turning them black, and at the same time invade the surrounding tissues, producing the symptoms described above. Not only may infection take place through the hydrathodes, but the bacterial can also infect the margins of wounds caused by biting insects or hail, and it is not unusual for holes in the leaves to be surrounded by the yellow "halo" characteristic of black rot.

Conditions Favouring the Disease.—Generally speaking, it may be said that the disease requires damp conditions in order to develop freely, so that it is not usual to experience trouble from black rot except during the rainy season. This year, however, many instances of severe infection of cauliflowers have been reported from all parts of the Colony during the months of April, May and June, and it is possible that this condition has resulted from the excessively heavy late rains which have been experienced. Even as late as the end of June quite serious infection of cabbage seedlings was noted, whilst many cases of stunting of cauliflowers have been caused by black rot disease. Thus it would appear that measures for control are necessary at all times of the year.

Control.—As stated above, the black rot bacterium can remain in the soil, from whence it may be transferred to growing plants. But this is not the only source of infection, for it is known that *Bacterium campestre* is a seed-borne organism, and experience in this Colony suggests that a good deal of seed sold locally may carry the parasite externally. In order to eliminate this source of infection, seed treatment is necessary. Two methods are recommended, namely, hot water treatment and disinfection with mercury compounds.

The hot water treatment consists of immersing the seed, tied up in a muslin bag, for thirty minutes in water kept at a temperature of 122° F. The use of an accurate thermometer is necessary, for if the temperature is allowed to rise above 122° F. germination will be adversely affected, whilst if a lower temperature is maintained death of all the bacteria cannot be guaranteed. Although this method is very effective, mistakes are liable to occur unless special apparatus is employed and for the general grower in the Colony it will probably be better to employ mercurial disinfectants.

The standard method is to immerse the seed in corrosive sublimate solution (one part to 1,000 parts water) for thirty minutes, in a manner similar to that employed with tobacco seed. Tablets, one of which added to 1 pint of water makes a 1-1,000 solution, may be obtained from most chemist stores. The treated seed must then be thoroughly washed in several changes of clean water and finally dried before being stored away. Quite recently the use of mercurial dusts has been recommended for seed treatment. One gram or half a level teaspoonful of dust is added to 1 lb. of seed placed in a tin having a tightly-fitting lid. The seed is then shaken for a few minutes until it is completely coated and the surplus dust is winnowed off. Small quantities of seed may be treated by placing a small pinch of dust in the packet, shaking for a short while and then removing the excess dust as before.*

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*Corrosive sublimate is a deadly poison and should be used with great care. Hands and all utensils employed should be thoroughly washed in hot water as soon as the operation is completed. It is inadvisable to smoke cigarettes whilst treating seed, as the poison may be transferred from the fingers to the mouth through the medium of the cigarette. If mercurial dust is used, precautions should be taken to avoid inhaling any of the disinfectant and winnowing of excess dust should be done in the open air.

As black rot bacteria can be harboured in the soil in minute fragments of diseased plant material remaining from a previous crop, cabbages, cauliflowers and other susceptible plants should not be grown consecutively in the same seed-beds or lands. Rotations are very necessary and all plant debris from infected crops should be collected up and destroyed. The disease may be spread by insects so that pest control should be vigorously prosecuted. Where cabbages or cauliflowers are grown on a large scale it is advisable to sterilise seed-beds by the open fire method before sowing, as is done with tobacco seed-beds. The young plants should be sprayed three or four times with Bordeaux mixture (4-4-50) plus arsenate of lead ($1\frac{1}{2}$lbs. to 50 gallons), to which a good spreader has been added. Although recommendations for seed-bed spraying do not appear in general literature on black rot, yet it has been found under local conditions to be very beneficial. It is essential that a fine mist-like spray be applied to the seedlings, and that a good spreader be incorporated in the spray fluid in order to ensure that the mixture will adhere uniformly to the waxy surfaces of cabbage and cauliflower leaves.

VERB. SAP.

The concluding paragraph of a recent pamphlet on the principles of *fumigation* of insect pests in stored produce, issued by the Department of Industrial Research, London, consists of the following single sentence:—

"Cleanliness, segregation of goods, etc., remain the foundation of pest control."

Not just another entomologist gone potty, but an indication of the modern trend in economic and practical insect control.

Cleanliness Aids Insect Control.

Book Review

An Agricultural Testament

By Sir Albert Howard, C.I.E., M.A.

(Oxford University Press, 1940. 15/- nett.)

This book may be said to embody a statement of the author's agricultural faith, developed after a long experience in investigating the origins of soil fertility and healthy crops and stock, in India and elsewhere.

The author is already well known by name to hundreds of Rhodesian farmers as the originator of the Indore process for composting farm wastes, which with some modifications is now widely practised in this Colony.

Sir Albert Howard's main theme is the essential virtue of humus in securing a truly fertile soil, but he goes much further than this and maintains that all health, that is, the health of the soil, of the crop and of the animal, both domestic and human, is directly dependent on humus. Decay, in other words, he claims, is the origin of healthy life. The decay of plant and animal-remains is the source from which springs healthy life upon the earth, and in the soil.

If we follow the author's lead we arrive back where agriculture was in the pre-Liebig era; where "muck" reigned supreme as a fertiliser of the soil, and "artificials" were still unknown.

He contends that the crop growing in a healthy "live" soil, that is one which has been adequately supplied with the right type of humus, is able to defend itself against pests and diseases without the adventitious and expensive aid of the mycologist and entomologist with their spray pumps and insecticidal dusts. Moreover, he maintains that animals, human or domestic, which are fed on crops grown on a truly healthy soil, will themselves be healthy, and therefore resist the attacks of the multitude of diseases, which the doctor and the veterinarian now attempt to combat by other means. Proper aeration of the soil by drainage and cultivation and the choice of the right variety or strain of any crop to suit the local conditions of soil are also considered to be prerequisites for ensuring this resistance to disease.

Empirical evidence in support of this hypothesis is to be found in this Colony in many farm flower and vegetable gardens where compost is regularly applied. But the author goes much further (pp. 79 and 166) in claiming that compost has been found to control the parasite of maize called Witch Weed (*Striga lutea*) than the writer of the note quoted, who specifically states that "no claim for this rough trial is made, of course, that it is proof that compost will control the parasite." In fact, subsequent evidence has been found to be conflicting.

The possible importance of the mycorrhizal association between the roots of plants and certain fungi in the proper nutrition of crops is emphasised. The author considers this to be one of the chief links between the soil and the crop, whereby the humus added to a soil may immediately be utilised as plant food, and the disease-resistance of the crop is increased. The addition of humus (such as compost) to the soil, which is lacking in it, brings about the appearance of the mycorrhizal association with the roots of crops where it was previously absent. In this Colony the mycorrhizal association has been shown by the Forestry Department to be essential to the successful establishment of various species of pines which without its aid failed to thrive. It is of particular local interest to note that the following crops amongst others have been proved by the author's investigations to be associated with mycorrhiza—coffee, tea, tung, vine, banana, cotton, sugar cane, strawberries, bulbs, grasses, clovers, maize and certain leguminous green-manure crops, one at least of which is a *Crotalaria*. Tobacco and many tropical leguminous plants are also associated with mycorrhiza.

In general Sir Albert Howard condemns green-manuring as being unreliable, and because it puts too great a strain on the soil in the rotting down of the crop, and he advocates that the green crop shall rather be converted into humus through the compost heap before it is incorporated in the soil. He mentions that this practice is already in operation in Southern Rhodesia. In South Central Africa, however, experience has shown that the climatic conditions favour the success of green-manuring in one very important respect, namely, in that a practically rain-free winter follows the ploughing in of the green-manure, and this tends to prevent the loss of soluble nitrates from the soil by leaching before the next crop is planted and ready to make use of them.

The faith of the author in humus as a means of overcoming all the ills of agriculture has possibly unconsciously led him to be hypercritical on the question of the effect of mineral fertilisers on soil fertility and crop production. The use of artificial fertilisers as a means of increasing crop production is not only condemned but is stated to result in a slow poisoning of the life of the soil, and to be one of the greatest calamities which has befallen agriculture and mankind. He goes further and says, "Artificial manures lead inevitably to artificial nutrition, artificial animals, and, finally, to artificial men and women." This statement would appear truly to exemplify the words of Browning, "Progress is the law of life. Man is not man as yet." Should Sir Albert ever be able to substantiate his claims some interesting problems can be visualised for investigation by the physiologists, biochemists and anthropologists of the future.

Many revolutionary theories are put forward by the author, and it is unfortunate that in the majority of cases no concrete evidence is included to substantiate them. Most practical farmers as well as those engaged in agricultural science in Tropical and Sub-Tropical Africa are fully aware of the rapidity with which organic matter in such soils is oxidised, and it will be universally acknowledged that the conservation and utilisation of all organic wastes for the production of soil humus is of the utmost value and importance to the farming community.

At the same time, however, the value of mineral fertilisers has been proved to the satisfaction of practical agriculturists, and there can be no doubt that they will continue to be used even by those equally convinced of the value of humus in promoting soil fertility. The contention of Sir Albert that maize grown in land manured with properly made humus and without the use of artificials is superior in quality to other maize and should be separately graded and sold will hardly be accepted by maize growers in this country upon the sole evidence that purchasers will soon discover that it suits their animals. For the present we prefer to pin our faith on the judicious application of artificial fertilisers to land in which the humus content has been well maintained.

Veterinarians too will have something to say to Sir Albert's theories regarding the resistance of bovines to such diseases as Rinderpest and Foot and Mouth Disease. The conclusions in this respect are rather loosely drawn, and no attempt was apparently made to confirm or disprove them by scientifically controlled experiments.

Part II. of this book includes a revised description of the Indore process for the manufacture of humus from vegetable and animal wastes and also an interesting account of its practical application in the growing of a number of tropical and sub-tropical crops in India, Kenya, Ceylon, Rhodesia and elsewhere, including cotton, maize, sisal, vegetables and sugar cane.

The author has coined a valuable phrase for describing the ideal moisture-content of the compost heap when he states that it should be "that of a pressed-out sponge." This should assist those who are making compost during the winter months in this Colony. The tendency is to use far too much water in the process.

The chapter on "Some Diseases of the Soil" is both interesting and informative, and deals with the causes and effects of soil erosion and also contains a good account of the formation of alkali soils.

In Part IV., Present-day Methods of Agricultural Research, are severely criticised. Sir Albert apparently favours greater freedom of action for the individual investigator in preference to the modern trend for research to be carried out by teams of specialised workers under the control of a central body. Attention is drawn to the large number of

Councils and Administrative Committees controlling agricultural research in Great Britain, and to the fact that a great deal of the time and energy of the research workers must be taken up in furnishing reports and information to these bodies. Sir Albert queries whether so much machinery is necessary, and suggests that a single agency such as the Ministry of Agriculture is all that is needed in the way of control. He also holds that the research worker is often insufficiently in touch with the practical issues of farming. His views on these matters are clearly and boldly expressed, and certain of his contentions will undoubtedly meet with the approval of many research workers, even though they may disagree with other of his opinions.

In an appendix Capt. J. M. Moubray, of Chipoli Estate, Shamva, has given an interesting account of his experience in making compost on a large scale, and states that "Last year the bill for artificials on Chipoli was roughly half of what is used to be, and if the state of the growing crops is any indication, the out-turn will increase by fifty per cent."

This is an extremely interesting book, stimulating to thought and well worth reading for that reason alone, even though one is unable to accept all of the author's hypotheses.

DEPARTMENT OF AGRICULTURE,
Salisbury.

Take the evil out of Weevil.

Control of Maize Weevil

(*CALANDRA ORYZAE*, L.).

By M. C. Mossop, A.F.C., M.Sc., Entomologist.

(*Concluded.*)

APPENDIX A.

STORAGE OF SEED MAIZE.

The storage of seed maize does not constitute as great a problem as storage of maize for consumption, because the quantities are usually smaller and most of the storage period is during the cold dry and hot dry seasons. Seed wheat, however, needs to be stored through the warm wet season. In both cases the value of the seed is greater than that of grain for consumption if any serious seed selection has been practised, and this fact justifies paying more attention to its preservation.

The seed should be thoroughly mature and dry before storage. Once maize is properly dry, it is unlikely to pick up more moisture during the period in which it is normally stored for seed, and the chances of serious weevil damage are accordingly smaller. The thorough drying of seed grain justifies some effort from the point of view of weevil control. Another possible benefit is suggested by germination tests, kindly carried out by the Technical Assistant to the Senior Plant Pathologist, of seven samples of maize maintained by the writer at individual constant moisture contents between 7.75% and 13.6% from October, 1935, to January, 1939. The three samples kept below 9.6% moisture germinated to the extent of 96% to 100% with very vigorous growth. That kept at 9.6% moisture content germinated to the extent of 88% with weaker growth, whilst the three above 9.6% decreased progressively in germination and vigour to the 12% germination and very poor growth shown by the sample of 13.6% moisture content.

Although properly selected seed should theoretically be free from weevil, in practice a slight, if unnoticeable, infestation will usually soon be present. The experience of individual farmers in the matter of weevil in seed maize will tell them whether, under their own conditions of storage, control measures apart from drying are necessary.

If tanks, bins, or steel drums are available, seed can be stored in these. They make fumigation with carbon bisulphide or with other fumigants a simple matter. (See Appendix C.) The drums should be kept covered with well-fitting lids during the period of storage. If they can be made air-tight, so much the better. For comparatively large quantities of seed, batteries of drums may often be impracticable, but they are available on some farms.

Where storage in bags is adopted, clean, dry, airy, easily sealed rooms should be set aside for the purpose in order that new infestation can be more easily avoided, or fumigation be effected if necessary. Unless other special measures are taken, a routine fumigation at the outset is advisable, provided that the seed is mature and dry. Thereafter, fumigation can be carried out at any time if it should appear necessary. (For details see Appendix C.)

No serious work has been done locally on the effects of mixing dusts with maize for weevil control, although this practice is known to have some value. Present drawbacks are the possible effect on the overseas market of contamination, and the contamination from the medical and legal points of view of food for local consumption. In many rural mills the grain is not subjected to thorough winnowing before being ground, and the dust would be mixed with the meal. From the point of view of seed protection, the grain is likely to be overloaded with dust to the partial exclusion of mercurial dusts that are applied for controlling diseases. Observations suggest, however, that a certain degree of control in seed grain and in grain for consumption can be effected by sprinkling finely divided dusts such as slaked lime, silicates, or rock phosphate beneath a stack and on each layer of bags in a stack, the outside of the stack being well coated. Alternatively, a liberal application below the stack and on all outside and top bags without sprinkling between bags may be sufficient.

Enquiries are being made concerning the feasibility of a combined fungicidal and insecticidal dust for mixing with seed grain.

APPENDIX B.

REINFORCED BRICK GRAIN BINS.

Plans for the construction of reinforced brick grain bins to hold from 100 to 250 bags of grain have been drawn by the Irrigation Department. Blue-prints are available to farmers, and also a schedule of materials.

The bin is of circular construction having a sloping concrete floor, nine-inch reinforced brick walls and a flat five-inch to seven-inch reinforced concrete roof. The internal dimensions of the bin of 100 bags capacity are 8 ft. 6 in. in diameter and of the same height, and the bin of 250 bags capacity is 11 ft. in diameter and 12 ft. 6 in. in height. The bin stands on a base of which the height is dictated by circumstances or convenience. Such a receptacle is suitable for standing in the open though it should preferably be shaded.

As regards requirements, the following is taken from the schedule of materials, and refers to the bin of 100 bags capacity: 4,750 bricks, 17 pockets cement, 7 cu. yds. sand, 3 cu. yds. stone, 5 bags lime, 5 sheets galvanised iron damp course, 200 ft. reinforcing rods, 650 yds. reinforcing wire, 12 lbs. bitumen, shuttering used in constructing concrete roof, and miscellaneous fittings. Those interested are urged to obtain a copy of the blue-print and schedule.

The roof of this bin accounts for much of the cement, sand and stone, all of the reinforcing rods, and all of the shuttering and supporting poles. No doubt many farmers who wish to adopt or experiment with bulk storage will seek to reduce the cost. Whilst no reduction is suggested below the roof, it is possible that the less lofty bins holding 100 or

200 bags of grain could be fitted with a cheaper roof if built under rain-proof verandahs, special outdoor shelters, or in store rooms. If desired, the roof could be removed later if it is eventually decided to build a concrete roof.

Such a roof might consist of rigid, anchored, farm-cut boards. Outside pieces will do, but they should be anchored flat side downwards. Straight poles would make a fairly effective substitute. The boards or poles should be supported by the top of the walls and by two heavy beams about 20 inches apart. The roof should be lined inside with a ceiling of glazed waterproof reinforced paper such as "Sisalkraft," nailed with closely spaced clouts to the roof boards. The component strips of paper should be glued together with Sankey's liquid glue or a similar adhesive. Where the periphery of the paper overlaps or meets the top of the wall, the joint should be made insect-proof and gas-proof by means of bitumen or roof-sealing compound.

A manhole, consisting of portion of a 44 gal. drum either flush with or projecting above the roof, can be fitted between the beams, which should be orientated to bring the manhole into a convenient position. When the paper ceiling is cut at the manhole, flaps should be left for sealing to the sides of the drum. The cover, which might be made of half or less of a larger drum, should fit over the manhole and rest in a mud seal or in a depth of about two inches of dry sand. A large plough disc with a handle fitted to and closing the bolt holes could be used to cover a flush manhole.

The top and edges of the roof should be plastered smoothly with mud as an additional sealing and in order to render useless to insects the many crevices that will result from this form of construction.

The above suggestions have not been tested out in practice but are offered as including the bare requirements from an entomological point of view of a cheap, farm-devised roof. An objection to this roof is that cracks and crevices in the beams will be available to insects as hiding places. This may be overcome by including the beams within the paper ceiling, or by covering them with a heavy coating of tar or other covering, or, with some sacrifice of strength and safety, by having the beams on top of the roof boards. It must be emphasised that this type of roof is suggested for use under rain-proof shelter only.

A battery of three square brick bins which would hardly be regarded by an expert as being suitable to withstand the pressure of grain, but which, nevertheless, has given satisfactory storage and satisfactory weevil control for four years, is in use on the premises of Messrs. Butler Bros., " Villa Franca," Glendale. Of the three, one has cracked down a considerable portion of one corner, but has been used for two seasons in this condition. The internal dimensions are about 10 ft. square by 12 ft. high. A tank of this size would hold about 275 bags of maize in bulk. The bins stand inside a shed with a rigid iron roof, and their tops are about level with the top of the walls, the slope of the roof leaving ample working space for filling the bins through manholes.

As the ground was tunnelled by termites, each bin was erected on a solid foundation of brick and cement two feet deep, topped by six inches of 1:3:3: concrete serving as the floor. On this the nine-inch walls were built of good quality farm brick and mud mortar. An outlet consisting of a short length of four-inch piping was let into the wall at the level of the floor of the bin. The floor was made to slope one foot from the opposite side.

When the walls reached about six feet in height, two stays of three-quarter inch piping were laid at right angles across the bin and built into the middle of the opposite walls. Where the ends projected from the outside of the walls old plough discs were later bolted onto them, forming large flanges to the piping and thus staying the walls against pressure from within. The walls were then completed and included four strands of barbed wire reinforcing which were anchored to the stays and carried up to strengthen four of the courses of brickwork above the stays. The inner faces of the walls were plastered with mud, as a good quality was available on the farm.

The roof was made of 12-foot corrugated iron sheets resting on the walls and supported in the middle by a single beam, and was sealed with mud. A square manhole was cut in the iron next to the beam at the front edge of the bin, its lid consisting of a square of the same material placed on top and sealed.

Although square bins may not be entirely satisfactory, that described above is an expression of the desire on the part of enterprising farmers for bulk storage. Messrs. Butler state that they are in every way satisfied with their storage, and that their bins paid for themselves in the first two years in the saving of sacks and in the saving of grain from insect pests, rats, and theft. Some suggested improvements would be the substitution of six-inch for four-inch outlets and the slight bending downwards of the cross stay pipes towards their centres. With a few holes drilled through their undersides, these pipes could be used for the introduction of fluid fumigants. As it happens, however, the owners have not needed to fumigate the grain stored in their bins. For greater strength, the reinforcement should be of high strain steel wire and the lower parts should be included, even if this were at the expense of the upper part. A stronger mortar should be used. For reducing the strain on walls, the dimensions should be less.

Whilst the erection of circular bins is advised a modification of the square bin briefly described above could be adopted as a substitute by those who are unable to overcome the conviction that circular bins are not suitable for their needs.

APPENDIX C.

FUMIGATION.

The fumigation of bulked grain can be carried out in a suitable receptacle such as a tank, drum, or tarpaulin, or of bagged grain, in a small room or under a tarpaulin. In all cases, the receptacle or chamber containing the grain must be made as air-tight as possible.

Carbon Bisulphide.—Although several new fumigants have been developed during the last few years, most of them are expensive either because of the cost of manufacture or because of the cost of transport in heavy cylinders. The demand would not at present justify local production. Carbon bisulphide, therefore, continues to be the main stand-by for fumigating grain.

Carbon bisulphide, known also as carbon disulphide, is a heavy, volatile liquid. A whisky or wine bottle holds two pounds; the standard dose per 1,000 cubic feet, namely, eight pounds (about five pints) is contained in four bottles. Carbon bisulphide is inflammable, and the vapour at a concentration represented by four pounds or more in 1,000 cubic feet of air makes an explosive mixture that can be set off by a flame or spark. The liquid boils at 115° F., and should therefore be stored in a cool place and never left in the heat of the sun. No spark or flame should be allowed near the exposed liquid or its fumes. The latter are heavy, and, like petrol fumes, may flow for some distance to a source of ignition and then backfire. (*N.B.*—Sparks may be made by boot nails on stone floors, electric switches or motors, the hammering of a steel drum, or even by static electricity.) The vapour, which is given off readily when the liquid is exposed, is somewhat poisonous to man and in extreme cases can cause death. A feeling of giddiness, headache, or nausea is a sign that danger is well advanced, and if such a feeling is noticed, fresh air must be sought immediately. An earlier sign is the apparent disappearance of the odour. Those who suffer from any weakness of the heart should be particularly careful.

Fumigated grain is not rendered unfit for consumption. If it smells of carbon bisulphide it can be spread out and aired for a few hours. The process of grinding also assists in airing.

The amount of carbon bisulphide to use depends to a large extent on the ability of the container to retain the fumigant in its gaseous form. In a metal tank that is hermetically sealed, four to six pounds per 1,000 cubic feet would be enough, but in practice six to eight pounds are used. Eight pounds will be effective in a brick bin, or in a room that is exceptionally well sealed. In a less air-tight room or under a tarpaulin, twelve or even twenty pounds or more are necessary. The foregoing quantities are given as a guide for the amount to use per 1,000 cubic feet of space in the empty container regardless of how much grain it may hold. The largest dose specified would chiefly be used in certain circumstances under which bagged grain may have to be fumigated, and reflect part of the price to be paid for lack of bulk storage facilities.

In making a receptacle or room air-tight for fumigation with a heavy gas such as carbon bisulphide, particular attention should be paid to the bottom and the lower part of the sides. Heavy paper sheets, or strips softened by being soaked in water, are good for pasting over cracks, etc.; gummed paper strips are handy. Newspaper pulp, roof sealing preparation, or mud is useful under many circumstances. The fumigant is scattered on the top surface of the grain or is poured on absorbant material such as a sack. The top of the container is closed tightly and preferably sealed. If it is preferred, the liquid can be poured into a clean shallow pan placed on top of the grain, but in this case the evaporation is less rapid. Evaporation from a pan is preferable if the grain is to be used for seed, for unless the seed is thoroughly dry germination may be affected by direct contact with the liquid. Fumigation of seed should continue for 36 hours; other grain should be left for three days, or even indefinitely.

A slight leak in a small container is more important than a leak of the same size in a large container, as the former allows a larger proportion of the enclosed gas to escape. Half a fluid ounce of liquid (one tablespoonful) would be ample to fumigate a 44-gallon steel drum full of grain if the drum is hermetically sealed, but if the drum is sealed by tying a double thickness of heavy paper over the top, at least one fluid ounce would be necessary. In a metal tank of larger proportions, this difference in sealing the manhole might require an increase of, say, one pound in a tank large enough to require a dose of six to eight pounds.

As the vapour of carbon bisulphide is 2.63 times as heavy as air, the fumigant should normally be placed on the top of the grain as described above. If the grain is deep, however, the fumigant should be divided proportionately and introduced through a pipe to each level of five feet or less in the container, the lowest level being not more than five feet from the bottom, and the highest on top of the grain.

Fumigant pipes may be built in from the sides as fixtures, or they may be inserted when and where required through the manhole. Where bins are wide lateral spacing also is desirable. This would necessitate several applications in different places at each level, and would involve, where fumigant pipes are built-in fixtures, several pipes at each level.

If it is desired to fumigate in bags, these can be stacked in a small room capable of good sealing, the bags being placed loosely, and directly on top of each other, not bonded or overlapping as is usual in ordinary stacking. The stack should be not more than five bags high. After the room is sealed except for the door, the fumigant is poured over the top, the room vacated, and the door sealed. If the stack is small compared with the size of the room, it is cheaper to cover it with a good tarpaulin and apply the dose according to the cubic contents under the tarpaulin. A space should be provided under the tarpaulin on top of the stack by placing two or more bags edgewise on the latter. This space facilitates the evaporation of the fumigant. The edges of the tarpaulin should be weighted down to the floor with sand or with "sausages" or "sand-snakes" made by filling with sand flexible tubes of about three inches in diameter and any convenient length, made of canvas or other strong cloth. The papered hessian used for wrapping tobacco bales would be useful if used with the paper on the inside.

Where the tarpaulin is large enough the bags can be stacked on the middle of it and the sides pulled up over the stack and rolled together or suitably weighted down on top.

After fumigation the tarpaulin should be removed from the top and sides of the stack, the room well aired, and the stack then re-built tightly.

Another method used for bagged grain is the pouring of two ounces of carbon bisulphide onto each bag as it is being stacked. This requires quick work to avoid loss of vapour and too much inhalation of it. The room is then sealed or the stack covered with a tarpaulin. The tarpaulin methods have been in use for fumigating grain in South Africa for over 35 years.

A room in which fumigation has taken place should be well ventilated before work is continued therein, whether the fumigation has been effected in an inner receptacle or not.

Cyanide Gas.—The use of hydrocyanic acid or "cyanide" gas for grain fumigation is less popular than that of carbon bisulphide. Whilst the former at fumigating concentrations does not have the inflammable and explosive properties of the latter, it is far more dangerous to human life. In very well sealed rooms, which are not commonly available on Rhodesian farms, bagged grain can be fumigated at the concentration produced by about 100 ounces of sodium cyanide per 1,000 cubic feet, or its equivalent for other sources of the gas. In tanks, half to three-quarters of this amount would be sufficient, but in this case calcium cyanide granules should be poured in evenly as the tank is filled with grain in a regular and uninterrupted flow. This does not at present fit in with normal farm procedure.

Three more practicable uses of cyanide gas in connection with grain are the fumigation of sheds, fumigation of comparatively small quantities of seed, and the killing of rats.

For the fumigation of a shed that does not contain stored products, about 20 to 30 ounces of sodium cyanide per 1,000 cubic feet can be used to kill the insects present. This concentration can also be used for the periodical fumigation of sheds containing grain. It will not kill all the weevils in the grain, but if applied, say, in October, in December or January, and in February or March it will kill many thousands of weevils that would normally be the progenitors of later heavy infestation. The first two of these fumigations are the more important for grain stored over the normal period, even though few weevils may be seen at the time.

For fumigating rats under a stack built on dunnage, about eight ounces or more of calcium cyanide powder of the "Cyanogas" type or half that quantity of the "Calcid" type per 1,000 cubic feet are pumped vigorously under the stack from several points by means of a special pump (costing under £4) after the space has been enclosed with bags of grain or other materials placed against the bottom of the stack. The pump can also be used for forcing the powder down rat holes or termite tunnels.

Seed can be fumigated by revolving it a few times together with half an ounce of calcium cyanide (*e.g.*, "Cyanogas") granules per bushel in the drum used for treating seed with fungicidal dusts, and then leaving it in the drum for 24 hours. If the drum is not air-tight it can be made so by pasting thick paper over the lid or other leaky places. A drum large enough to treat a bag at a time will enable 25 to 30 bags of seed to be treated in a month at the expenditure of a few minutes' labour and about 2d. to 2½d. a day for the fumigant. A commercial leaflet on the subject is obtainable from Messrs. Fraser & Chalmers, Ltd., Salisbury.

No cyanide gas treatment should be attempted by persons inexperienced in this type of fumigation until he has studied the subject. A full account of cyanide fumigation appeared in the *Rhodesia Agricultural Journal* in March and April, 1939, and is available as Bulletin No. 1105.

Methyl Bromide.—Of the newer gases, methyl bromide is believed to be of exceptional value in fumigating grain. Its high penetrating power and toxicity allow much lower concentrations to be used than are necessary with many other fumigants. Its toxicity to humans is somewhat insidious as the gas has no persistent odour, although it is said to cause a dryness on the nose and watering of the tongue. It is not inflammable. The gas is 3¼ times as heavy as air. The liquid boils at just over 40° F. and the fumigant is therefore stored and transported in liquid form under pressure, either in cylinders or in one-pound or half-pounds tins. One pound per 1,000 cubic feet of space surrounded by non-absorbent walls is a sufficient amount for grain, though under many circumstances one and a half pounds will be necessary. Package in tins makes its transport to countries like Rhodesia both economical and convenient. The cost in Southern Rhodesia should be considerably less than the present cost of the quantity of carbon bisulphide that would obtain the same results.

Fumigation with methyl bromide under tarpaulins is not advised unless the tarpaulin be of rubberised canvas or some similar gas-proof material. Although ordinary canvas is fairly effective in confining the vapours of carbon bisulphide, it is of little use where methyl bromide is concerned, so penetrating are the vapours. Moreover, the cost of rubberised sheets is such that it would be cheaper to erect a special fumigating chamber or medium sized grain bin complete with concrete roof than to buy an outsize but practicable sheet. This comparison is not intended as a reflection on methyl bromide, but as emphasis of its penetrating power and as propaganda in favour of bulk storage.

No specific directions will be given at present for the use of methyl bromide, for although the Department has a supply the fumigant is not yet commercially available locally. Moreover, there are a few details that must still be decided upon for the adjustment of known procedure to local conditions. It is hoped to write a more complete account at a later date.

Pyrethrum and White Oil.—A method incorrectly described as fumigation, but which may be valuable against insects attacking bagged grain in store rooms that can be properly closed but not necessarily sealed, is the frequent periodical atomising of a strong mixture of pyrethrum with white oil at high pressure. For the best results expensive equipment is necessary, but it is probable that less expensive equipment may be used, though more laboriously, in small store rooms. The method as used against bed bugs was described in this *Journal* in February, 1940 (or Bulletin No. 1145). Its practical use in a room containing bagged maize, however, is the subject of projected tests.

Farming Calendar.

OCTOBER.

CITRUS FRUITS.

Citrus trees should not be permitted to suffer for want of water if a good setting of fruit is desired. Continue irrigation at fairly frequent intervals, especially if it is windy. Cultivation must follow each irrigation when the soil is fit to work, otherwise a large amount of moisture will be lost by evaporation. The packing of late fruit for export should be completed early in the month or before the rains commence. If rains intervene, the carrying properties will be affected and the fruit will probably break down in transit. Suppress all stem growths or water shoots as they appear. Young trees planted last season may with advantage have the stems whitewashed or washed with Bordeaux mixture paste; this will prevent undue sun-scalding of the unprotected stems. Plant cover crops with the first good rains.

CROPS.

If not already attended to, overhaul all farming implements and replace worn parts to ensure efficiency. Shell ground nuts required for the season's planting. Ploughing of old lands should, at latest, be finished this month. If seed potatoes will not keep in good condition until next month, they may be planted now, but later planting is better. Edible canna may be planted this month before rain falls. Also velvet beans, dolichos beans and sunn hemp towards the end of the month for green manuring. Harvest winter cereals and plough under the stubbles as soon as possible after harvest. When rains have fallen, use every effort to improve the tilth of the lands which will be the first to be planted. On cloddy lands already ploughed, seize the opportunity to break down the clods by disc and drag harrowing as showers of rain fall. A spiked roller is very useful for this work. A good tilth means good planting, and a good stand of maize; therefore do everything possible by cross ploughing, disc and drag harrowing to bring the soil into good condition for seeding.

When necessary, keep the harrows going to check early weed growth. Clean lands at this time of year are an insurance against cutworm and other insect pests. If weather conditions permit, plant a crop of maize to attract the stalk borer. New land to be ploughed and intended for planting this season should be cleared of heavy grass or weeds by burning or cutting to ensure good work being done by the ploughs. Seasonal showers of rain are liable to spoil bricks unburned. See that bricks which have been made are protected from rain. Clean out guttering and down-spouts of house and farm buildings. Press on with development work so as to have this completed before rains break.

DAIRYING.

During the month of October and until such time as the rains have commenced and green grazing is available, dairy stocks require to be almost entirely stall fed. Cows in milk and cows due to calve should be liberally fed on succulents and concentrates in order that they may commence the dairying season in good condition, and make full use of the early grazing for milk production. Dairy cows that are underfed at this time of the year invariably produce milk of poor quality, and usually throw weedy undersized calves; furthermore, they do not pick up in condition until comparatively late in the season.

During October the cow's ration should consist of succulents such as silage or green feed, etc., legume hay of good quality and a liberal allowance of concentrates; a pound or so of a feed such as ground-nut cake is invaluable for dairy stock at this time of the year.

Weather conditions are generally fairly warm during the month of October, and every precaution should be taken to keep the cream, which is used for butter-making or which is sent to the creamery, as cool as possible. The can or bucket containing the cream should be placed in a basin of water or concrete trough, in the dairy, and exposed to a draught; a piece of kaffir blanket, which dips into the water, should be wrapped around the can or bucket containing the cream. Churning of cream for butter-making is best carried out early in the morning—before sunrise if possible; the coolest water obtainable should be used for washing the butter whilst in the granular stage.

At this season of the year cheese-makers may find that the milk is deficient in butter fat; this is generally the result of under-feeding or unsuitable feeding. Cheese made from milk of low fat content is invariably dry and hard, defects that are accentuated by over cooking the curd or by cooking at too high a temperature. The curd should be firmed in the whey at a temperature not higher than 98° F. to 100° F.

FLOWER GARDEN.

All flower seeds, annual and perennial, may be sown as in September A word or two on open seed beds may not be out of place here. These beds should be prepared in a sheltered position, and the soil should be well and deeply dug. This is most essential, as in this state the soil when once watered is more easily kept moist, and is not so liable to cake. The top dressing should be free from all undecayed vegetable matter, and when sown, the seeds should be covered with a thin dressing of fine light soil, over which a thin covering of grass may be placed to check evaporation. Transplanting from boxes or beds should be done on a dull day or towards evening; the plants should be well watered before being removed, and the roots disturbed as little as possible, care being taken that the latter have their full depth and spread when planting.

VEGETABLE GARDEN.

As in September, nearly all vegetable seeds may be sown. Early potatoes should be earthed up when reaching the height of about eight inches. In planting a small amount of marrow, melon, cucumber, and pumpkin, the writer has found it economical to sow the seed one in a tin and transplant when about four inches high in hills. A few cucumbers, planted in this manner yielded nearly 400 a week for about two months. Sweet corn and maize may also be sown this month.

FORESTRY.

The main sowings of eucalypt (gum) seed should be made either in seed trays or in well prepared seed beds. A well-broken soil forming a fine tilth in the seed bed ensures more successful germination and better plants. If transplants are being used, any seedlings which are ready should be pricked out.

Seedlings in open beds may have their tap roots cut so as to develop fibrous lateral roots, and thus produce good type stocky plants. Remember the plant feeds through its roots, hence the better the root system the healthier the plant and the greater its chances of successful establishment. If conditions are favourable, cross-plough and harrow land for planting broken up in early autumn.

POULTRY.

October is usually a hot month, and poultry keepers should therefore see that their birds have access to shade during the day. At the same time they should have plenty of air. One often sees birds during hot weather sitting under dense bushes, which is almost worse than no shade at all.

All houses should be examined and, if necessary, repaired. It is advisable to repeat the caution that birds must have dry quarters.

Many poultry keepers do not realise the vital necessity of giving their birds, especially the young stock, plenty of succulent green food during the hot weather. It should be cut up and placed in boxes or hoppers about 7.30 a.m. and 5 p.m., and, if very hot, also at noon; it should never be placed in the sun. As much as the birds will eat should be supplied. Lack of it, especially during hot weather, causes a reduced output of eggs, smaller eggs and light-coloured yolks; further, a disease known as "nutritional disease," is likely to affect the birds and cause deaths. The symptoms are much like those of eye roup, without the well-known offensive smell of roup. It is due to the fact that vitamine A, which is present in large amounts in all succulent green foods, and which is so necessary for nutrition, is lacking. There is no doubt that many chickens and fowls die each year from this cause.

Ducks.—These during the hot weather require even more shade than do fowls; they cannot stand the direct rays of the sun nor sultry heat. The houses should always have dry floors, and should be overhauled before the rains commence. Ducks sleeping on damp floors often contract rheumatism and cramp. The floor of the duck house should be raised a few inches, thus ensuring a dry bed.

As many ducklings should be hatched as possible now, provided, of course, there is the prospect of a sale for them at ten weeks old. They thrive best in the wet weather.

Turkeys.—Stop hatching until after the wet season is over. To rear turkeys in the wet weather entails a good deal of time, labour, expense and often losses. Once a young turkey chick gets wet, it will probably die; at any rate, it will never be the same bird it would have been had it not got wet. Give the older turkeys all the range possible; the further afield they go the better grown birds they become, and less is the expense of feeding. See also that their roosting quarters are water-tight before the rains commence.

STOCK.

Cattle.—Ranching cattle on granite veld will in many instances be in fairly good condition on account of the early grass in the vleis, etc. On the diorite soils and later veld the cattle owner will still have to watch his weaker cattle carefully. In any case all supplies of hay, ensilage, majordas, etc., should be carefully husbanded in anticipation of possible late rains, but at the same time every effort should be made to prevent cattle becoming weak. Dairymen will need to feed highly both with succulents and green foods. Calves should be weaned and branded if this has not already been done, and care should be taken that they do not suffer any serious setback by reason of want of feed. The question of a mineral mixture should receive consideration.

Sheep.—If spring lambs are expected, one should see that the sheep-shed is in order, and that there is a supply of hay, ensilage or mealies for the poorer ewes in the event of late rains. All drinking places should be cleansed out, and care taken that the water supply is sufficient. Ewes for winter lambing should be well looked after, so as to get them up in condition before they are put to the ram next month. General shearing may start, including the April-May lambs.

TOBACCO.

Continue to sow seed beds. Where grass has been put on the seed beds to assist germination of seed a daily inspection should be made, and as soon as the first few plants make their appearance the grass should be raised up a little from the bed in order to prevent the plants growing "spindley." All possible preparation for the coming planting season should be made.

Rhodesian Milk Records.

SEMI-OFFICIAL.

COMPLETED LACTATIONS.

Name of Cow.	Breed.	Milk in Lbs.	B. Fat in Lbs.	Average % B. Fat.	No. of Days.	Name and Address of Owner.
Blackie	G. Friesland	4,685.30	245.51	5.24	279	J. R. Bedford, Poltimore, Marandellas.
Helen	G. Guernsey	3,907.80	215.27	5.51	300	
Peggy I.	G. Guernsey	6,158.70	226.76	3.68	300	
Star	G. Shorthorn...	5,147.50	201.96	3.92	300	
Twinkle	G. Friesland	7.415.50	279.02	3.76	300	
Sunday	G. Friesland	6,173.50	251.19	4.07	300	Boyd Clarke Est., Castle Zonga, Inyazura.
Suzanne	G. Friesland	7,451.50	283.54	3.81	260	
Spotty	G. Friesland	6,497.50	278.86	4.29	300	K. M. Campbell, Hedon Farm, Marandellas.
No. 86	G. Friesland	6,371.50	246.17	3.86	300	Coldstream Dairy, P.O. Headlands.
No. 242	G. Friesland	7,986.00	255.91	3.20	300	
No. 243	G. Friesland	5,585.50	205.82	3.69	262	
No. 274	G. Friesland	7,054.00	254.13	3.60	285	
No. 276	G. Friesland	6,316.50	233.55	3.70	300	
No. 281	G. Friesland	5,696.50	212.70	3.73	247	
Lola	G. Friesland	6,038.50	209.09	3.46	300	F. Grossman, Esq., Kenilworth, Rusape.
Boncella	G. Friesland	8,216.70	291.03	3.54	300	Mrs. E. D. Knill, Mendamu, Marandellas.
Bromtje	G. Friesland	7,291.30	249.68	3.42	300	
Jesse	G. Friesland	7,909.10	270.82	3.42	300	
Ella	G. Red Poll	4.951.80	210.88	4.26	261	A. H. MacIlwaine, Larkhill, Marandellas.
Larkhill Rita	G. Red Poll	5,778.60	230.46	3.99	292	
Betty	G. Friesland	4,731.70	210.45	4.45	275	H. A. Coke Norris, Laverstock, Umtali.
Paris	G. Friesland	5,201.40	201.68	3.88	300	Red Valley Est. "P" Herd, Lushington, Marandellas.
Annie	G. Friesland	5,961.00	205.09	3.44	300	P. S. Timms, Esq., Chitora, Rusape.

The Farm Home

Picnic Lunches

By Miss E. E. Coutts.

In times of peace many housewives are faced with difficulties when it comes to thinking out a suitable midday meal for a member of the family who cannot get home for that meal. The problem becomes increasingly difficult in time of war, when the man of the family may be away all day on military training and a well-balanced, sustaining luncheon which can be carried easily has to be supplied. The following hints may be found of use:—

1. Avoid food which will break easily, such as flaky pastries.

2. Where possible wrap each piece separately in greaseproof paper or bag. This prevents food drying or crushing, and in addition keeps each piece fresh until it is required.

3. If sandwiches are used brown bread keeps moist longer than white. Wrap up in lettuce leaves, a cabbage leaf or in greaseproof paper with damp butter muslin round.

4. Give variety as much as possible and try to balance the food value. Fresh fruit or green salad should always be included and avoid too much starch.

5. Pack food into container or parcel as tightly as possible to avoid it breaking. If necessary pad any holes with crumpled paper to avoid food sliding about in the package.

6. Tie parcel up securely.

7. Beverages should be tightly corked. When a thermos flask is used for tea never add milk to the tea; put it in a separate bottle.

8. The cork of a thermos flask should have a piece of greaseproof paper wrapped round lower edge completely before placing in position in flask.

The following are some recipes which will give variety and change.

BREAKFAST SAUSAGE.

Ingredients.

1 lb. beefsteak.

$\frac{1}{4}$ lb. bacon.

Salt and pepper (about $\frac{1}{2}$ teaspoonful salt, $\frac{1}{4}$ pepper)

About $\frac{1}{8}$ nutmeg.

1 egg.

Brown crumbs.

Method.

1. Mince steak and bacon finely.
2. Mix meat, salt and pepper, grated nutmeg.
3. Beat egg and mix in with egg to bind to stiff consistency.
4. Form into thick roll.
5. Turn on to floured pudding cloth. No flour should get inside roll, or when it is cooking the starch grains bursting will cause roll to split. There should be no cracks.
6. Roll up in cloth and tie at ends
7. Put into pan of boiling water.
8. Boil from 2-2$\frac{1}{2}$ hours.
9. Remove from pan; drain, unroll.
10. Roll in dried brown crumbs. Leave until cold. Serve cut in thin slices with bread and butter or put into sandwiches.

RAISED PORK AND MUTTON PIES.

Ingredients.

For Pastry.

8 ozs. flour.

2 ozs. lard.

$\frac{1}{2}$ gill hot water.

$\frac{1}{2}$ teaspoonful salt.

For Filling.

$\frac{1}{2}$ lb. pork.

1 teaspoonful mixed herbs.

1 hard boiled egg.

Stock to moisten.

1 teaspoonful chopped parsley.

Seasoning.

Method.

1. Prepare meat and cut into small pieces.

2. Slice egg.

3. Mix together meat, egg, chopped parsley, seasoning and stock.

4. Make pastry as follows:—

5. Sift flour and salt.

6. Put lard and hot water into pan and just bring to the boil.

7. Pan into centre of flour, stirring and mixing quickly whilst hot.

8. Cut into three pieces.

9. Knead one piece until free from cracks. Keep the other two warm.

10. Cut off one-third and keep warm in basin.

11. Mould larger piece into cup shape about 3 inches diameter. Work as quickly as possible. Keep edges straight, 1-1½ inches high.

12. Fill tightly with one-third mixture and stock.

13. Roll out the piece of pastry (one-third) which had been set aside, as a round lid.

14. Moisten edge and put on lid.

15. Seal and flute edges.

16. Make hole in centre to allow impure gases to escape.

17. Decorate as liked—usually three rectangular pieces of pastry as leaves.

18. Brush over with egg.

19. Repeat from 9 with both the other pieces; this gives three pies.

20. Bake in hot oven to commence with, then reduce heat to cook meat through from three-quarter to one hour.

21. Serve hot or cold.

Note.—Mutton, veal and ham; a chicken may be substituted for the pork, in which case omit herbs.

CHEESE AND POTATO CUSTARD.

Ingredients.

¼ lb. short crust pastry (4 ozs. flour, 2 ozs. butter, salt, cold water).

½ lb. small firm cooked potatoes.

2 ozs. grated cheese.

1½ eggs or 2 small ones.

About ¼ pint milk.

Seasoning.

A little nutmeg.

Pinch cayenne pepper.

Few shaves of butter.

Method.

1. Prepare all ingredients and make short crust.

2. Roll out and line greased 6 inch shallow tin (1½ to 2 inches deep).

3. See pastry is well against sides of tin.

4. Slice potatoes; if large cut across.

4. Arrange slices overlapping in bottom of tin.

6. Beat up egg, add nutmeg, cayenne, salt, cheese and milk.

7. Pour over potato.

8. Bake in bottom of hot oven; when just setting put on shaves of butter. Time ½-¾ hour.

Some dishes which are suitable for packing easily.

Meat Dishes.

Sausage rolls made with short crust.

Cornish pasties.

Fried bread used for sandwiches with savoury mixture between slices.

Egg and bacon pie.

Sweets.

Doughnuts.

Fruit and nut bread.

Fruit flans.

Apple pie.

Other fruit pies.

Boston bread.

Date or raisin loaf.

Departmental Bulletins.

Copies of these Bulletins may be obtained from the Editor, Box 387, Salisbury. They are issued to residents of Southern Rhodesia at a charge of 3d. per copy and at 6d. per copy outside the Colony.

N.B.—The date the article appeared in the Journal is indicated in abbreviated form before the number, e.g., 8/22, No. 429, means that Bulletin 429 appeared in the Journal for August, 1922.

AGRICULTURE AND CROPS.

7/25. No. 545. Artificial or Synthetic Farmyard Manure, by H. G. Mundy, Dip.Agric., F.L.S.

5/27. No. 643. Noxious Weeds in Southern Rhodesia, by F. Eyles, Botanist.

12/27. No. 663. The Use of Fertilisers and Manures in Southern Rhodesia, by A. D. Husband, A.I.C., Chief Chemist.

2/28. No. 674. Top Dressing of Maize against Stalk Borer, by H. C. Arnold.

3/28. No. 681. The Sunflower (Helianthus Annuus) (Revised), by S. D. Timson, M.C., Dip.Agric.

6/28. No. 695. The Castor Oil Plant (Ricinus spp.), by S. D. Timson, M.C., Dip.Agric.

9/28. No. 705. Suggested Cropping Programmes for Farms on the Sand Veld, by D. E. McLoughlin, Assistant Agriculturist.

10/28. No. 710. Monthly Reminders for the Farming Year, by the Division of the Chief Agriculturist.

3/29. No. 727. Farmyard Manure, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.

7/29. No. 743. Sunn Hemp, by S. D. Timson, M.C., Dip.Agric.

9/29. No. 751. The Sweet Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).

10/29. No. 758. Instructions for Taking Soil Samples. Issued by the Division of Chemistry.

1/30. No. 768. The Ground Nut (Arachis hypogaea), by S. D. Timson, M.C., Dip.Agric. (Wye).

3/30. No. 776. Regulations Governing the Export of Maize and Maize Meal through the Port of Beira.

11/30. No. 797. Green Manuring: An Essential Practice in Rhodesian Farming, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief Agriculturist.

1/31. No. 802. Witch Weed, by S. D. Timson, M.C., Inter.B.Sc. (Agric.) London., Dip.Agric (Wye), Assistant Agriculturist.

3/31. No. 815. New Strains of Oats for Southern Rhodesia, by H. C. Arnold, Manager, Agricultural Experiment Station, Salisbury.

4/31. No 816. Preliminary List of the more Common Grasses of Southern Rhodesia, by Sydney M. Stent, Botanist for Pasture Research.

5/31.	No. 822.	Re-stacking of Maize rejected for Export on account of Excessive Moisture.
9/31.	No. 826.	Some Poisonous Plants of Southern Rhodesia, by Sydney M. Stent, Senior Botanist.
10/31.	No. 831.	Revised Notes on Cotton Growing in Southern Rhodesia, by G. S. Cameron.
11/31.	No. 836.	The Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).
12/31.	No. 837.	Veld Grass Silage: A Feature in Rhodesian Pasture Management, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief, Division of Plant Industry.
6/32	No. 855	Pigeon-hole Method of Stacking Maize, by Division of Plant Industry.
8/32.	No 859.	Twenty-one Years of Plant Introduction, by Major Mundy, Chief Division of Plant Industry.
2/33.	No 878.	A.I.V. Silage: Memorandum prepared and circulated by Imperial Bureau of Animal Nutrition.
11/34.	No. 936.	Witchweed, by S. D. Timson, M.C. Dip.Agric. (Wye), Assistant Agriculturist.
10/35	No 970	Rhodes Grass for the Southern Rhodesian Tobacco Grower, by African Explosives and Industries, Ltd
11/35	No 972	Notes on Witchweed, by S. D. Timson, M.C., Dip.Agric (Wye), Assistant Agriculturist.
6/36	No 992.	Annual Report of the Agriculturist for the year 1935, by D E. McLoughlin, Agriculturist.
8/36.	No 997.	Reward Wheat: Report on the Baking Properties and Chemical Analyses, by The Rhodesian Milling and Manufacturing Co , Ltd.
4/37	No. 1022	Smut Diseases of Wheat in Southern Rhodesia, by G. M Wickens, B Sc. Agric., Ph.D , D.I C., Plant Pathologist, Tobacco Research Station, Trelawney.
9/37.	No. 1044.	Farming Calendar.
10/37.	No. 1046.	Green Manuring: Two Important Factors Affecting Success, by S. D. Timson, M.C., Assistant Agriculturist, and H. C. Arnold, Manager, The Agricultural Experiment Station.
10/38.	No. 1084.	Improved Pastures, by S D. Timson, M.C., Assistant Agriculturist.
11/38.	No. 1089.	Witchweed and the Labour Shortage, by S. D Timson, M.C., Assistant Agriculturist.
2/39.	No. 1101.	Grass Silage, by H. C. Arnold, Manager, Salisbury Experiment Station
10/39.	No. 1129.	Pyrethrum, by H. C. Arnold, Manager, Agricultural Experiment Station, Salisbury.
11/39.	No. 1131.	Witchweed, by Division of Agriculture.
12/39.	No. 1136.	Compost, by S. D. Timson, M.C., Assistant Agriculturist
1/40.	No. 1137.	Compost Notes, by S. D. Timson, M.C., Assistant Agriculturist.
5/40.	No. 1153.	Field Selection of Seed Maize, by Alan Rattray, Junior Agriculturist.
7/40.	No. 1158.	Kudzu (*Puerania Thunbergiana*), Cultivation and Propagation, by H. C. Arnold, Manager, Salisbury Experiment Station.

REPORTS ON CROP EXPERIMENTS.

7/27.	No. 649	Annual Report of Experiments, 1925-26, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Manager.

4/28.	No. 683.	Annual Report of Experiments, 1926-27, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Station Manager.
7/29.	No. 745.	Salisbury Agricultural Experiment Station Annual Report, 1927-28, by H. C. Arnold.
7/30.	No. 789.	Agricultural Experiment Station, Salisbury. Annual Report of Experiments, 1928-29, by H. C. Arnold.
9/31.	No. 830.	Salisbury Agricultural Experiment Station, Annual Report, 1929-30, by H. C. Arnold, Manager.
10/32.	No. 864.	Annual Report, 1930-31: Agricultural Experiment Station, by H. C. Arnold, Station Manager.
6/33.	No. 895.	Salisbury Agricultural Experiment Station Annual Report, 1931-32, by H. C. Arnold, Manager.
3/34.	No. 914.	Gwelo Municipal Demonstration Station: Final Report, 1933, by S. D. Timson, M.C., Dip.Agric (Wye), Assistant Agriculturist.
9/35.	No 965.	Salisbury Agricultural Experiment Station Annual Report, 1933-34, by H. C. Arnold, Manager.
5/39.	No. 1110.	The Management and Utilisation of Natural Pastures, by H. C. Arnold, Manager, Salisbury Experiment Station.
6/39.	No. 1113.	Wheat Production in Southern Rhodesia, by D. E. McLoughlin, Agriculturist.
4/40.	No. 1149.	Salisbury Agricultural Experiment Station: Agriculturist's Annual Report on Experiments, Season 1938-1939, by H. C. Arnold, Manager.

TOBACCO.

8/26.	No. 605.	Flue-curing Tobacco Barns, Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.
9/26.	No. 615.	The Culture of Virginia Tobacco in Southern Rhodesia: Field Management, by D. D. Brown.
5/27.	No. 641.	The Handling, Grading and Baling of Cured Virginia Tobacco, by D. D. Brown.
5/27.	No. 644.	Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.
9/27.	No. 653.	The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)
11/27.	No 661.	Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16 ft., by B. G. Gundry.
1/28.	No. 665.	Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
2/28.	No. 671.	Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.
12/28.	No. 715.	Turkish Tobacco Culture in Southern Rhodesia, by D. D. Brown, Chief Tobacco Expert.
3/29.	No. 728.	Suggested Crop Rotations for Tobacco Growers, by D. D. Brown, Chief Tobacco Expert.
4/29.	No. 734.	Common Faults in Curing Virginia Bright Tobacco, by D. D. Brown, Tobacco and Cotton Expert.
8/29.	No. 748.	Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
9/29.	No. 753.	Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
2/30.	No. 771.	Dark Fire-cured Tobacco: Field Operations, by D. D. Brown, Chief Tobacco Expert.

3/30.	No. 774.	Dark Fire-cured Tobacco: Harvesting and Curing, by D. D. Brown, Chief Tobacco Expert.
6/30.	No. 784.	Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.
3/31.	No. 812.	Selection of Tobacco Seed Plants, by H. F. Ellis, M.Sc., B.S. (Agric.), Tobacco Adviser.
11/31.	No. 835.	Tobacco Culture: Transplanting Operations, by D. D. Brown.
3/32.	No. 846.	Leaf Curl in Tobacco, by Dr. H. H. Storey.
3/33.	No. 885.	Tobacco Culture in Southern Rhodesia: The Harvesting and Curing of Virginia Tobacco, by D. D. Brown, Chief Tobacco Officer.
8/36.	No. 996.	The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.
12/36.	No. 1009.	Tobacco Research on the Trelawney Station 1935-36 Season.
4/37.	No. 1025.	Report of the Tobacco Research Board, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture and Chairman of the Tobacco Research Board.
5/37.	No. 1026.	Notes on Tobacco Root-Knot Nematode, by J. C. Collins, B.Sc., Biologist, Trelawney Tobacco Research Station.
8/37.	No. 1039.	Some Tobacco Pests that can be serious, by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.
1/38.	No. 1054.	Alkalinity of Tobacco Seed-bed Soils, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.
3/38.	No. 1063.	A New and Serious Disease of Tobacco in Southern Rhodesia, by G. M. Wickens, Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.
6/38.	No. 1072.	Report of the Tobacco Research Board for the year ending 31st December, 1937, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture, and Chairman of the Tobacco Research Board.
5/40.	No. 1154.	Host Plants of the Tobacco Aphis (*Myzus persicae*), by Chas. K. Brain, M.A., D.Sc.

LIVE STOCK.

1/27.	No 624.	The Construction of Dipping Tanks for Cattle (Revised).
1/31.	No. 801.	Sheep Farming in the Melsetter District, by J. C. Kruger, Part-time Sheep Adviser in the Melsetter District.
10/32.	No. 863.	Piggeries, by B. G. Gundry, A.I.Mech.E.
12/32.	No. 871.	Some General Observations on the Feeding of Dairy Cows on a Mixed Stock Farm, by Dr. A. E. Romyn, Senior Animal Husbandry Officer.
4/33.	No. 887.	The Type of Chiller Steer required for Export, by A. E. Romyn, Senior Animal Husbandry Officer.
9/33.	No. 903.	The Handling, Preparation and Chilling of Cattle for Export, by C. A. Murray, Lecturer in Animal Husbandry.
12/33.	No. 907.	The Blackhead Persian: Its Breeding and Management in Matabeleland, by C. A. Murray, M.Sc., Lecturer in in Animal Husbandry, Matopo Estate.
1/34.	No. 909.	Stall Fed Chillers for the Overseas Christmas Market, by C. A. Murray, M.Sc., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.
2/34.	No. 912.	Economical Winter Rations for Wintering Dairy Heifers, by C. A. Murray, M.Sc. (Agric), Lecturer in Animal Husbandry, Matopo School of Agriculture.

4/34. No. 916. Cowpea Hay in the Ration for Bacon Pigs, by C. A. Murray, M.Sc. (Agric.), Lecturer in Animal Husbandry, Matopo School of Agriculture and Experiment Station.

6/34. No. 924. Raising Dairy Calves on a Limited Amount of Whole Milk, by C. A. Murray, M.Sc., Agr., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

1/35. No. 943. Cattle Improvement and a Cattle Breeding Policy in Southern Rhodesia: A Review of the General Position Chiefly as regards Ranching Cattle, by Dr. A. E. Romyn, Chief Animal Husbandry Officer.

1/35. No. 945. A Home-made Cow Stanchion, by Major R. R. Sharp, Whinburn, Redbank.

5/35. No 952. Annual Report of the Chief Animal Husbandry Officer for the year ending 31st December, 1934, by A. E. Romyn, Chief Animal Husbandry Officer.

7/35. No. 959. The Selection of a Dairy Bull, by A. E. Romyn, Ph.D., Chief Animal Husbandry Officer.

4/36. No. 984. Report on the Curing of Rhodesian Hides, by Advisory Committee on Hides and Skins of the Imperial Institute.

4/36. No 985. Export of Frozen Porkers. Third Consignment to Smithfield. Division of Animal Husbandry.

5/36. No. 987. The Curing of Hides and Skins on the Farm, by The Division of Animal Husbandry.

5/36. No. 988. Preparing Cattle for Show, by The Animal Husbandry Division.

6/36. No. 989. The Supplementary Feeding of Mineral and Protein Supplements to Growing Cattle in Southern Rhodesia and its Relation to the Production of Beef Steers, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Southern Rhodesia; D. G. Haylett, Ph.D., Director, Rhodes Matopo Estate; F. Ericksen, Dip. Agric., Experimentalist.

9/36. No. 1000. Sheep Management on the Mixed Farm, by R. H. Fitt, Animal Husbandry Officer.

10/36. No. 1001. The Raising of Bacon Pigs, by A. E. Romyn, Chief Animal Husbandry Officer, and C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate, with a Veterinary Section by D. A. Lawrence, Director of Veterinary Research.

4/37. No. 1023. Cowpea Molasses Silage for Fattening Steers, by C A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture. Salisbury; R. H. Fitt, Dipl. Agric., Animal Husbandry Officer, Department of Agriculture, Salisbury.

4/37. N. 1024. Comparative Feeding Value of Maize Meal and Nyouti (*Pennisetum Typhoides*) Meal for Fattening Steers, by C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Chief Animal Husbandry Officer.

5/37. No. 1027. The Feeding of Phosphorus Supplements to Growing Cattle by C. A Murray and A E Romyn.

5/37. No 1029. The Dehorning of Cattle intended for Slaughter and Export, by B. A. Myhill, Assistant Chief Veterinary Surgeon.

5/37. No. 1030. The Feeding of Different Winter Supplements to young growing steers and the effect of these supplements on the subsequent development and costs of production of the steers, by C. A. Murray and A. E. Romyn.

6/37. No. 1032. The Effects of Feed on the Firmness and Grading of Bacon Carcases, an experiment carried out by the Division of Animal Husbandry in co-operation with Mr. A. L. Millar, Estes Park, Salisbury, and Mr. Frank Neill, of Neill's Bacon Factory, Salisbury.

6/37. No. 1034. Nyouti or Munga (*Pennisetum typhoides*) as a Feed for Bacon Pigs, by C. A. Murray and A. E. Romyn.

7/37. No. 1036. Preliminary Report on the Feeding of Winter Supplements to young growing steers and the effect of supplementary feeding on the subsequent development of these animals, by C. A. Murray and A. E. Romyn.

12/37. No. 1049. The Export of Frozen Porkers: Report on Five Consignments of Porkers Exported to Smithfield, by Division of Animal Husbandry.

1/38. No. 1053. The Feeding of Sunnhemp Hay as compared with Cowpea Hay in the Fattening Ration for Bullocks, by A. E. Romyn and R. H. Fitt

2/38. No. 1058. Pig Industry Act, 1937. Division of Animal Husbandry.

9/38. No. 1083. Internal Parasites in Sheep, by Percy D. Huston, M.R.C.V.S., District Veterinary Officer.

11/38. No. 1091. Cost of Fattening Bullocks of various ages in Matabeleland, by A. E. Romyn and C. A. Murray.

7/39. No. 1120. Urea as a possible substitute for Peanut Cake for Wintering Young Stock, by C. A. Murray and A. E. Romyn.

6/39 No. 1115. Feeding Young Stock in Winter, by C. A. Murray, M.Sc. (Agr.) and A. E. Romyn, Ph.D., Division of Animal Husbandry, Department of Agriculture, Southern Rhodesia.

1/40. No. 1140. The Summer Fattening of Bullocks, by the Division of Animal Husbandry.

2/40. No. 1143. Larger Calf Crops will increase your Profits, by C. A. Murray, Senior Animal Husbandry Officer in Charge, Government Experiment Station, Matopos.

DAIRYING.

12/30. No. 799. The Objects of Ripening Cream for Butter-making, and a few Hints on Cream Production, by F. Lammas, Dairy Officer.

9/32. No. 862. Cream Cheese, by F. A. Lammas, Dairy Officer.

3/33. No. 880. Dairy Tests and Calculations, by F. A. Lammas, Dairy Officer.

5/34. No. 922. Dairy Building in Southern Rhodesia: A Small Farm Dairy, by G. B. Gundry, A.I.Mech.E.

7/34. No. 926. Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.

12/34. No 937. Gouda or Sweet Milk Cheese, by F. Lammas, District Dairy Officer.

2/36. No. 977. Notes on the Feeding of Dairy Cows during the Summer Months, by A. E. Romyn, Chief Animal Husbandry Officer.

6/36. No. 990. Southern Rhodesia Milk Recording Scheme.

12/37. No. 1051. The Production and Handling of Milk and Cream, by the Dairy Branch.

12/38. No. 1094. Farm Butter Making, by The Dairy Branch.

VETERINARY.

12/25. No. 570. The Spaying of Bovines, by G. C. Hooper Sharpe, M.C., M.R.C.V.S., and M. H. Kingcombe, M.R.C.V.S.

6/26. No. 597. Suspected Poisoning of Stock: The Proper Procedure, by M. H. Kingcombe, M.R.C.V.S. (Lond.), and A. W. Facer, B.A. (Oxon.), A.I.C.

12/26. No. 618. Notes from the Veterinary Laboratory: Quarter Evil, by Ll. E. W. Bevan, M.R.C.V.S , Director of Veterinary Research.

1/28. No. 666. Notes from the Veterinary Laboratory: Praemonitus—Praemunitus, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

10/29. No. 756. Parasitic Gastritis of Cattle, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

11/29. No. 760 A Note on Sheep Diseases in Southern Rhodesia, by D. A. Lawrence, B.V.Sc., Veterinary Research Officer, Department of Agriculture, Salisbury.

2/30. No 772. Notes from the Veterinary Laboratory: Ophthalmia, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

4/31. No. 819. Measles in Swine, by P. D. Huston, M.R.C.V.S.

1/32. No. 841. Poisonous or Suspected Poisonous Plants of Southern Rhodesia: Tulip Poisoning of Cattle, by Sydney M. Stent, Senior Botanist, and D. A. Lawrence, B.V.Sc., Veterinary Research Officer.

10/32. No. 866. The Treatment of Intestinal Parasites of Sheep, by J. D. Coutts, D.V.S., M.R.C.V.S.

4/33. No. 886. A Preliminary Note on Contagious Granular Vaginitis in Southern Rhodesia, by D. A. Lawrence, B V.Sc., Acting Director Veterinary Research.

2/40. No. 1142. Low Birth-rate of Calves and Calf Mortality, by B. A. Myhill, M.R.C.V.S., Chief Veterinary Surgeon.

IRRIGATION, WATER SUPPLIES AND SOIL EROSION.

4/27. No. 640. Levelling for Irrigation, by Dr. W. S. H. Cleghorn, M.I.Mech.E.

11/27. No. 659. The Hydraulic Ram, revised by P. H. Haviland, B.Sc

11/28. No. 668. The Water Act, 1927, by C. L. Robertson, B.Sc. (Eng.), A.M.I.C.E.

1/28. No 670. Irrigation Canals, by P. H. Haviland, B.Sc. (Eng.).

6/30. No. 786. Low Concrete Dams, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

2/31. No 808. The Application of Water in Irrigation, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

3/31. No 811. Irrigation Canal Structures, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

8/32. No. 860. Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

2/33. No 879. Conditions Governing the Hire of Government Boring Machines.

6/35. No 956. Annual Report of the Division of Irrigation for the year ended 31st December, 1934, by P. H. Haviland, B.Sc. (Eng.), Acting Chief Irrigation Engineer.

9/35.	No. 967.	How to use an Engineer's or Farm Level, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E., Irrigation Engineer (Matabeleland).
12/35.	No 973.	Domestic Water Supplies and Sanitation on the Farm, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E.. Irrigation Engineer (Matabeleland).
3/36.	No. 980.	Results from Glenara Soil Conservation Experiment Station, 1934-35 Season, by C. L. Robertson, B.Sc. A.M.I.C.E., Chief Engineer, Irrigation Division, and A. D. Husband, F.I.C., Chief Chemist.
8/36.	No. 999.	Lining an Irrigation Furrow, by R. H. Roberts, B.S.. A.M.Inst.C.E., Assistant Irrigation Engineer.
1/38.	No. 1052	Small Earthen Storage Dams. Part I. By the Irrigation Division.
2/38.	No. 1055.	Small Earthen Storage Dams. Part II. By the Irrigation Division.
3/38.	No. 1061.	Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.
7/38.	No. 1077.	A Small Brick Irrigation Furrow, by H. W. H. Wallis, Assistant Irrigation Engineer.
1/39.	No. 1095.	Soil and Water Conservation, by D. Aylen, for the Irrigation Division.
9/39.	No. 1127.	Soil and Water Conservation. Part III. By D. Aylen and the Irrigation Officers.
3/40.	No. 1144.	The Ridger Grader, by D. Aylen and the Irrigation Department.
4/40.	No. 1148.	Contour Planting and Terracing of Orchards, by D. Aylen and the Irrigation Department.
6/40.	No. 1155.	Soil and Water Conservation. Part IV. Prevention and Control of Gullies, by D. Aylen and the Irrigation Officers.

FORESTRY.

11/29.	No 763.	The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B.Sc.F.
1/30.	No. 769.	The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B.Sc.F.
4/30.	No. 778.	The Utilisation of Wood in Southern Rhodesia—Conversion and Disposal of Timber, by T. L. Wilkinson. M.Sc., B.Sc.F., District Forest Officer.
8/30.	No. 791.	The Utilisation of Wood in Southern Rhodesia: Fencing, by T. L. Wilkinson, M.Sc., B.Sc F., District Forest Officer.
7/32.	No. 857.	Charcoal Burning on the Farm, by R. J. Allen, Forester, Rhodes Matopo School of Agriculture and Experiment Station.
11/32.	No 869.	Wind-breaks and Shelter Belts, by A. A. Pardy, B.Sc., Forestry.
1/33.	No. 874.	Tree Planting, by the Division of Forestry.
4/33.	No. 888.	The Vegetable Ivory Palm (Hyphoene ventricosa), by G. M. McGregor, B.Sc., District Forest Officer, Matabeleland.
8/34.	No. 928.	Some Trees, Shrubs, Shrubby-Herbaceous Plants, Climbers and Water Plants suitable for the Colony, by J. W. Barnes, Manager, Government Forest Nursery, Salisbury.

12/35.	No. 974.	Summary of the Annual Report of the Division of Forestry for the year 1934, by E. J. Kelly-Edwards, M.A., Dip. For. (Oxon.), Chief Forest Officer. Price List of Forest-tree Transplants, Ornamental Trees Shrubs, Hedge Plants, Creepers and Seeds obtainable at the Government Forest Nursery, Salisbury.
10/37.	No. 1045.	Seventeenth Annual Report of the Division of Forestry for the Year 1936, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.
6/38.	No. 1073.	Pruning of Plantations, by R. H. Finlay, B.A., Oxon., Division of Forestry.
7/38.	No. 1076.	Eighteenth Annual Report of the Division of Forestry for the year 1937, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.
10/38.	No. 1085.	The Pot Planting of Eucalypts, by Major G. R. Wake, Vigila, Umvukwes.
11/38.	No. 1087.	The Raising and Planting of Trees on the Farm, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon), Conservator of Forests.
1/40.	No. 1138.	Nineteenth Annual Report Division of Forestry for the year 1938, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.

HORTICULTURE

4/27.	No. 637.	Harvesting, Packing and Marketing of Deciduous and Tropical Fruits, by G. W. Marshall, Horticulturist.
8/27.	No. 650.	Coffee Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.
2/29.	No. 725.	Investigations into "Collar-Rot" Disease of Citrus, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)
11/31.	No. 834.	Celery Culture, by G. W. Marshall, Horticulturist.
2/33.	No. 876.	Notes on African Aloes (Parts 1-6), by H. Basil Christian, "Ewanrigg," Arcturus.
10/33.	No. 905.	Notes on African Aloes (Parts 7-10), by H. Basil Christian, "Ewanrigg," Arcturus.
5/34.	No. 920.	Citrus Fruit Growing in Rhodesia, by G. W. Marshall, Horticulturist.
5/37.	No. 1028.	Tomato Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.
2/39.	No. 1100.	The Rhodesian Home Orchard, by G. W. Marshall, Horticulturist.
4/40.	No. 1150.	The Health of Seed Potatoes, degeneration due to virus diseases is the greatest source of loss. Journal of the Ministry of Agriculture, December, 1939.

ENTOMOLOGY AND PLANT PATHOLOGY.

2/13.	No. 139.	Termites, or "White Ants," by Rupert W. Jack, F.E.S
6/15.	No. 214.	Some Household Insects, by R. Lowe Thompson, B.A.
2/21.	No 385.	The Common Fruit Beetle, by R. W. Jack, F.E.S.
12/24	No. 522	Notes on the Black Citrus Aphis, by C. B. Symes.
8/25.	No. 548.	Insect Pests of Cotton, by C. B. Symes.
9/27.	No. 653.	The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad).
1/28.	No. 665.	Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
2/28.	No. 671.	Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.

6/28.	No. 696.	Ticks Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
11/28.	No. 714.	Trap Cropping against Maize Pests, by Rupert W. Jack, F.E.S., Chief Entomologist.
3/29.	No. 732.	Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.
6/29	No. 742.	What is Diplodia in Maize? An Answer to a Popular Question To-day, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
9/29.	No. 754.	"Pinking" of Maize: Report of a Preliminary Investigation, by T. K. Sansom, B.Sc., Plant Breeder.
6/30.	No. 784.	Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.
6/30.	No. 788.	A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T A., Plant Pathologist.
		A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond), A.I.C.T.A., Plant Pathologist. Supplement No. 1.
7/30.	No. 790.	Notes on the Control of Some of the More Important Insect Pests of Citrus in Southern Rhodesia, by W. J. Hall, Ph.D., B.Sc., Entomologist to the British South Africa Company in Southern Rhodesia.
10/30.	No. 796.	The Army Worm (Laphygma exempta, Wlk.), by Rupert W. Jack, Chief Entomologist.
11/30.	No. 798.	The Preparation of Bordeaux Mixture and Seasonal Notes on Tobacco Diseases, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.
1/31.	No. 804.	Locusts in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.
3/32.	No. 848.	Mycological Notes: Seasonal Notes on Tobacco Diseases: 3, Frog Eye; 4, White Mould; by J. C. F. Hopkins, B Sc. (Lond.).
4/32.	No. 850.	Pests of Stored Tobacco in Southern Rhodesia, by M. C. Mossop, M.Sc., Entomologist.
6/32.	No. 856.	A List of Plant Diseases occurring in Southern Rhodesia, Supplement 2, by J. C. F. Hopkins, B.Sc. (Lond.), Government Plant Pathologist.
9/32.	No. 861.	Further Notes on Leaf Curl of Tobacco in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.
5/33.	No. 892.	The Tsetse Fly Problem in Southern Rhodesia, by R. W. Jack, Chief Entomologist.
5/33.	No. 893.	Experiments with Tsetse Fly Traps against Glossina Morsitans in Southern Rhodesia, by R. W. Jack, Chief Entomologist.
6/33.	No. 894.	Mycological Notes. Seasonal Notes on Tobacco Diseases. 6. An Unusual Type of Frog Eye Spotting, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.
6/33.	No. 896.	A List of Plant Diseases occuring in Southern Rhodesia. Supplement 3. (New Records for period June, 1932, to May, 1933.) Compiled by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.
7/33.	No. 897.	The Report of the Chief Entomologist for the year ending 31st December, 1932, by Rupert W. Jack, F.E.S., Chief Entomologist.
8/33.	No. 899.	The Black Maize Beetle (Heteronchus Licus Klug), by C. B. Symes,

2/34.	No. 911.	Screw Worm. A Pest of Ranch Cattle in Southern Rhodesia, by A. Cuthbertson, Entomologist. Foreword by R. W. Jack, Chief Entomologist.
3/34.	No. 913.	Locusts: Instructions for dealing with Flying Swarms, by The Division of Entomology.
4/34.	No. 917.	The Life History of the Screw-worm Fly, by Alexander Cuthbertson, Entomologist.
10/34.	No 934.	Mycological Notes. Seasonal Notes on Tobacco Diseases. 7, Spraying in Seed-beds and Lands, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
1/35.	No. 942.	Mycological Notes. Seasonal Notes on Tobacco Diseases. 8, The Mosaic Mystery. 9, Danger Points in Field Spraying, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
4/35.	No. 950.	The Control of Tsetse Fly in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.
4/35.	No 951.	Suspected "Streak" Disease of Maize. Notice to Growers, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
6/35.	No. 957.	Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1934, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
8/35.	No. 962.	The Report of the Chief Entomologist for Year ending 31st December, 1934, by R. W. Jack, Chief Entomologist.
10/35.	No 969	The Objects and Value of Seed Treatment of Maize against Diplodia, by G. M. Wickens, Ph.D. (Lond.), D.I.C., Assistant Plant Pathologist.
5/36.	No. 986.	Annual Report of the Division of Entomology for year ending 31st December, 1135, by Rupert W. Jack, Chief Entomologist.
7/37.	No. 1037.	Division of Entomology: Annual Report for year 1936, by R. W. Jack, Chief Entomologist.
8/37.	No. 1040.	A Programme for the Control of Diseases of Apple Trees in Southern Rhodesia, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
10/37.	No. 1047.	Mycological Notes: Seasonal Notes on Tobacco Diseases. X.: Precautionary Methods in Seed-beds, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
12/37.	No. 1050.	An Unusual Winter Outbreak of Maize Weevil *Calandra oryzae*, L.), by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.
2/38.	No. 1059.	A Poison Bait for Young Locust Hoppers.
6/38.	No. 1071.	Common Diseases of Apples and their Control in Southern Rhodesia, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., and Aline L. Bacon, B.Sc., Division of Plant Pathology.
6/38.	No. 1074.	A Note on a Stem Rot of Sweet Peas, by J. C. F. Hopkins, D.Sc., A.I.C.T.A., Senior Plant Pathologist.
7/38.	No. 1078.	Mycological Notes: Seasonal Notes on Tobacco Diseases. II. Two Destructive Curing Moulds, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
8/38.	No. 1079.	Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1937, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist

8/38. No. 1080. Annual Report of the Division of Entomology for the year ended 31st December, 1937, by Rupert W. Jack, Chief Entomologist.

9/38. No. 1082. The Life History of Root Gallworm or Root Knot Eelworm, by M. C. Mossop, M.Sc., Entomologist.

10/38. No. 1086. The Spraying of Tobacco Seed-beds and Control of Rosette Disease, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist, and M. C. Mossop, M.Sc., Entomologist.

1/39. No. 1097. Cleanliness Aids Insect Control: Some Examples of Agricultural Hygiene, by M. C. Mossop, M.Sc., Entomologist.

4/39. No. 1108. Three Important Strawberry Diseases, by J. C. F Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

8/39. No. 1121. Report of the Division of Entomology for the year ending 31st December, 1938, by J. K. Chorley, Acting Chief Entomologist.

8/39. No. 1122. Report of the Branch of Plant Pathology for the year ending 31st December, 1938, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

10/39. No. 1128. Mycological Notes. 12. The Diplodia Danger, by J. C. F. Hopkins, D.Sc., A.I.C.T.A., Senior Plant Pathologist.

11/39. No. 1132. Mycological Notes. 13. The Diplodia Danger, by J. C. F. Hopkins, D.Sc., A.I.C.T.A., Senior Plant Pathologist.

12/39. No. 1134. Mycological Notes. 14. Seasonal Notes on Plant Diseases, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

3/40. No. 1145. The Bed Bug and a new aid for its control, with special reference to native quarters, by M. C. Mossop, M.Sc., Entomologist.

5/40. No. 1152. Diseases of Fruit, Flowers and Vegetables in Southern Rhodesia. I.—Common Diseases of Apples and their Control, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., and Aline L. Bacon, B.Sc., Division of Plant Pathology.

6/40. No. 1156. Mycological Notes. 15—The Tobacco "Kromnek" Virus in Rhodesia, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

POULTRY.

1/29. No. 721. Poultry Keeping in Rhodesia: Pedigree Breeding, by H. G. Wheeldon, Assistant Poultry Expert.

6/29. No. 740. Artificial Incubation, Breeding and Rearing of Chicks, by H. G. Wheeldon, Poultry Expert.

11/29. No 761. Housing and Feeding of Adult Stock, by H. G. Wheeldon, Poultry Expert.

1/31. No. 803. Geese, by G. H. Cooper, Assistant Poultry Officer.

9/31. No. 827. The Ideal Brooder, by F. Roberts, Assistant Poultry Officer.

10/32. No. 865. Poultry Industry: Care of Young Stock in Hot Weather, by H. G. Wheeldon, Chief Poultry Officer.

11/32. No. 870. Trap Nests, by B. G. Gundry, A.I.MechE. (combined with No. 875).

12/32. No. 872. The Rearing and Fattening of Table Poultry, by H. G. Wheeldon, Chief Poultry Officer.

3/33. No. 884. The Vitamins in Poultry Feeding, by G. H. Cooper, Poultry Officer, Matopo School of Agriculture and Experiment Station.

5/34. No 918. The Moulting of Poultry: The Normal and Pullet Moult, by H. G. Wheeldon, Poultry Officer.

3/34. No. 947. Modern Culling of Laying Hens, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.

9/35. No. 966. Egg Marketing Bill: Draft of a Bill having for its purpose the more orderly Marketing of Eggs.

The following pamphlets can be obtained from the Poultry Officer upon application:—

Selecting Birds for Laying Tests, by A. Little, Poultry Expert.
Tuberculosis, by A. Little, Poultry Expert.
Prevention of Disease among Poultry, by A. Little, Poultry Expert.
Preparing Birds for Show, by A. Little, Poultry Expert.
The Fowl Tick (Argas persicus), by A. Little, Poultry Expert.
Culling: A Seasonal Operation, by A. Little, Poultry Expert.
Choosing a Male Bird, by A. Little, Poultry Expert.
The Breeding Stock, by A. Little, Poultry Expert.
Diseases of the Digestive System, by A. Little, Poultry Expert.
Mating for Improvement and Increased Egg Production, by A. Little, Poultry Expert.
Partial Moult: Broodiness. Selection of Layers of Large Eggs, by A. Little, Poultry Expert.
Exhibiting Eggs at Shows, by A. Little, Poultry Expert.
Condition of Birds on Show, by A. Little, Poultry Expert.
Green Food: The Result of not Supplying Sufficient to Poultry, by A. Little, Poultry Expert.
Good and Bad Hatching Eggs, by A. Little, Poultry Expert.
Grading Fowls, by A. Little. Poultry Expert.
Housing: Three Important Essentials, by A. Little, Poultry Expert.
Advice to Prospective Poultry Farmers, by A. Little, Poultry Expert
Seasonal Hints—August, by A. Little, Poultry Expert.
Successful Chick Rearing, by H. G. Wheeldon, Assistant Poultry Expert.
Hints to Breeders, October, by A. Little, Poultry Expert.
Abnormalities in Eggs, by A. Little, Poultry Expert.
Hints to Breeders. Prepare for the Breeding Season, by A. Little.
Respiratory Diseases, by A. Little, Poultry Expert.
Selection and Preparation of Fowls for Exhibition, by H. G. Wheeldon, Poultry Expert.

The Close of the Hatching Season and After, by H. G. Wheeldon, Poultry Expert.

7/38. No. 1075. The Artificial Incubation, Brooding and Rearing of Chickens, by H. G. Wheeldon, Poultry Officer.

11/38. No. 1090. A Cheap Portable Colony House for Poultry, by G. H. Cooper, Assistant Poultry Officer.

12/38. No. 1092. Feeding and Drinking Appliances for Poultry, by G. H. Cooper, Assistant Poultry Officer.

5/39. No. 1111. Ducks on the Farm, by H. G. Wheeldon, Poultry Officer.

12/39. No. 1135. Feeds for Pou'try and How to Use Them, by G. H. Cooper, Arsistant Poultry Officer.

METEOROLOGICAL.

12/22. No. 436. The Possibility of Seasonal Forecasting and Prospects for Rainfall Season, 1922-23, by C. L. Robertson, B.Sc., A.M.I.C.E.

12/24. No. 524. The Use of an Aneroid Barometer, by C. L. Robertson, B.Sc., A.M.I.C.E.

2/25.	No. 532.	The Short Period Forecast and Daily Weather Report, by C. L. Robertson, B.Sc., A.M.I.C.E.
6/25.	No 542.	Review of the Abnormal Rainfall Season, 1924-25, by C. L. Robertson, B.Sc., A.M.I.C.E.
10/28.	No. 712.	The Time, and How to Find It, by N. P. Sellick, M.C., B.Sc. (Eng.).
10/31.	No. 832.	The Weather Map and the Short Period Weather Forecast, issued by the Meteorological Office.
2/33.	No. 877.	Clouds and Weather in Southern Rhodesia, by N. P. Sellick, M.C., B.Sc., Meteorologist.

AGRICULTURAL BUILDINGS.

4/26.	No. 588.	Concrete on the Farm, by N. P. Sellick, M.C., B.Sc. (Eng.), Assistant Irrigation Engineer.
8/26.	No. 605.	Flue-curing Tobacco Barns. Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.
5/27.	No. 644.	Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.
11/27.	No. 661.	Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16ft., by B. G. Gundry.
10/32.	No. 863.	Piggeries, by B. G. Gundry, A.I.Mech.E.
5/33.	No 889.	The Construction of Dipping Tanks, by B. G. Gundry, A.I.Mech.E.; and Notes on their Management, by J. M. Sinclair, M.R.C.V.S., Chief Veterinary Surgeon.
9/33.	No. 902.	Brick-making on the Farm, by A. C. Jennings, Assoc.M.Inst.C.E.
12/33.	No. 908.	A Charcoal Safe or Cooler, by B. G. Gundry, A.I.Mech.E., Irrigation Division.
5/34.	No. 922.	Dairy Building in Southern Rhodesia: A Small Farm Dairy, by B. G. Gundry, A.I.Mech.E.
7/34.	No 926.	Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.
10/36.	No. 1002.	A Simple Farm Gate, contributed by the Division of Forestry.
5/37.	No. 1031.	Cattle Bale Grip.
8/37.	No. 1041.	Feeding Pens for Bullocks: the Layout at Estes Park, near Salisbury.
1/39.	No. 1098.	The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.

CHEMISTRY.

12/29.	No. 762.—	The Value of Rock Phosphate and "Bone and Superphosphate" as Fertilisers for Maize Production, by A. D. Husband, Chief Chemist.
4/32.	No. 852.	Mixing of Fertilisers: A Guide to Methods of Calculation, by the Division of Chemistry.
1/34.	No. 910.	The Toxicity to Grazing of Grass Sprayed with a Solution of Sodium Arsenite, by A. D. Husband, F.I.C., and J. F. Duguid, M.A., B.Sc.
5/35.	No. 954.	Experiments on the Toxicity to Fowls of Arsenite of Soda and Poisoned Locusts, by J. K. Chorley, F.R.E.S., and R. McChlery, B.A., B.Sc.
4/36.	No. 983.	Annual Report of the Branch of Chemistry for year ending 31st December, 1935, by A. D. Husband, F.I.C., Chief Chemist.
7/37.	No. 1035.	Analyses of Rhodesian Foodstuffs, by The Division of Chemistry.

MISCELLANEOUS.

4/28.	No. 686.	The Land Bank, Its Functions and How it Operates, by S. Thornton.
4/28.	No. 687.	The Use of Explosives on the Farm, by P. H. Haviland, B.Sc. (Eng.).
9/28.	No. 707.	Wood-Charcoal in Southern Rhodesia, by T. L. Wilkinson, B.Sc., Assistant Forest Officer.
5/31.	No. 820.	The Great Economic Problem in Agriculture—No. 1, by J. R. McLoughlin, M.Sc. (Economist), Economic Adviser.
6/31.	No. 823.	The Law of Supply and Demand—No. 2, by J. R. McLoughlin, M.Sc. (Economics), Economic Adviser.
		Twelve Simple Rules for the Avoidance of Malaria and Blackwater.
		Summary of the Game Laws of Southern Rhodesia.
11/34.	No. 935.	The Weeds and Poisonous Plants of Southern Rhodesia, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture. Part I.
8/35.	No. 961.	A Home-made Ridger. Contributed by Mr. Douglas Aylen, Somerset, Concession.
1/36.	No. 975.	Fertilizers, Farm Foods, Seeds and Pests Remedies Ordinance, 1914.
2/36.	No. 979.	The Prospects of Black Bass in the Inland Waters of Southern Rhodesia. Specially contributed.
6/36.	No. 991.	Silage and Silos.
8/36.	No. 998.	Summary of the Game Laws of Southern Rhodesia.
3/37.	No. 1018.	Veld Fires. The "Forest and Herbage Preservation Act, 1936," by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Chief Forest Officer.
3/37.	No. 1021.	Breaking in Young Oxen to the Yoke, by J. B. West, Dromoland, P.B. Lonely Mine.
7/37.	No. 1038.	Star Bur-weed (*Acanthospermum australe*, O. Kuntze), by Chas. K. Brain, D.Sc., Director of Agriculture.
8/37.	No. 1042.	Weeds of Southern Rhodesia. Part II. By Chas. K. Brain, D.Sc., Director of Agriculture.
2/38.	No. 1056.	Notes on the Cashew Nut. By C. K. Brain, Director of Agriculture.
2/38.	No. 1057.	The Preservation of Farm Beacons and how to make use of the Fencing Law.
2/38.	No. 1060.	How to make Tobacco-Wash on the Farm, by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.
3/38.	No. 1064.	Farm Roads, by Stuart Chandler, Chief Road Engineer.
4/38.	No. 1065.	Nitrification in Red Soil in the Salisbury Area, by A. P. Taylor, M.A., B.Sc., and B. S. Ellis, B.Sc., A.I.C., D.I.C., Agricultural Chemists.
4/38.	No. 1067.	Grass Mowers, by H. Beynon, from "The Farmer," March 4th, 1938.
4/38.	No. 1068.	The Control of Veld Fires, by The Division of Forestry.
9/38.	No. 1081.	Uncontrolled Grass and Forest Fires and their Prevention, by the Rev. Father A. B. Burbridge, S.J.
11/38.	No. 1088.	How to Instal a Simple and Efficient Hot Water Supply on a Farm, by W. A. Welch, Tantallon Farm, Salisbury.
1/39.	No. 1096.	Trees and Wild Flowers on the Rhodesian Farm. Part I. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

2/39.	No. 1099.	Trees and Wild Flowers on the Rhodesian Farm. Part II. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.
3/39.	No. 1102.	Trees and Wild Flowers on the Rhodesian Farm. Part III. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.
4/39.	No. 1106.	Trees and Wild Flowers on the Rhodesian Farm. Part IV. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.
5/39.	No. 1109.	Summary of the Game Laws of Southern Rhodesia, as at 1st May, 1939.
5/39.	No. 1112.	Trees and Wild Flowers on the Rhodesian Farm. Part V. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.
6/39.	No. 1116.	Trees and Wild Flowers on the Rhodesian Farm. Part VI. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.
7/39.	No. 1119.	Trees and Wild Flowers on the Rhodesian Farm. Part VII., by Chas. K. Brain, M.A., D.Sc., Director of Agriculture.
4/39.	No. 1103.	Scurvy and How to Prevent It. Public Health Pamphlet No. 3.
4/39.	No. 1105.	Fumigation with Hydrocyanic Acid Gas, by M. C. Mossop, M.Sc.
4/39.	No. 1107.	Some Notes on Game Bird Preservation, by W. E. Poles, Esq., on behalf of the Wild Life Protection Society of Southern Rhodesia.
6/39.	No. 1114.	The Rhodes Inyanga Estate.
7/39.	No. 1118.	Grass Fires and Fire-belt Burning, by J. R. Perrins, P.B.S. Ranch, Fort Rixon.
8/39.	No. 1123.	Trees and Wild Flowers on the Rhodesian Farm. Part VIII. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.
8/39.	No. 1124.	Cattle Bale or Grip.
9/39.	No. 1125.	Trees and Wild Flowers on the Rhodesian Farm. Part IX. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.
9/39.	No. 1126.	The Course of Prices of Certain Agricultural Products in Salisbury, by the Acting Government Statistician.
11/39.	No. 1130.	The Conditions Governing the Hire of Government Boring Machines, by Major C. E. Goad, M.C., Boring Superintendent.
12/39.	No. 1133.	Trees and Wild Flowers on the Rhodesian Farm. Part X. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.
1/40.	No. 1139.	Trees and Wild Flowers on the Rhodesian Farm. Part XI. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.
2/40.	No. 1141.	Government Loans and Subsidies, etc., for soil and water conservation, green manuring and artificial fertilisers.
3/40.	No 1146.	Trees and Wild Flowers on the Rhodesian Farm. Part XII. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.
3/40.	No. 1147.	A Home-made Cow Stanchion, by Major R. R. Sharp, Whinburn, Redbank.
5/40.	No. 1151.	Working Loam Soils for High Yields, by D. Aylen.
7/40.	No. 1157.	Some Hints for Cotton Growers, by G. S. Cameron, Empire Cotton Growing Corporation.

Southern Rhodesia Veterinary Report.

JULY, 1940.

DISEASES.

No fresh outbreak of scheduled diseases.

TUBERCULIN TEST.

Sixteen cows on Leachdale farm, Insiza district, were re-tested during the month. There were no reactors.

MALLEIN TEST.

One horse was tested upon importation, with negative results.

IMPORTATIONS.

From Union of South Africa: Horses 1, sheep 1,056.

From Bechuanaland Protectorate: Slaughter cattle 1,662, sheep 308, goats 37, pigs 30.

EXPORTATIONS.

To Northern Rhodesia: Sheep 46, goats 40, bulls 14, horses 7.

To Portuguese East Africa: Slaughter cattle 120.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

To United Kingdom: Beef quarters (chilled quality), 15,335; boneless beef quarters, 3,291; pig carcases, 100; bacon, 4,698 lbs.; tongues, 15,683 lbs.; liver, 43,536 lbs.; hearts, 12,979 lbs.; tails, 11,799 lbs.; skirts, 5,744 lbs.; shanks, 9,553 lbs.; kidneys, 2,909 lbs.; fat, 3,840 lbs.; cheeks, 5,058 lbs.; tongue roots, 4,951 lbs.

To Northern Rhodesia: Beef carcases, 10; offal 836 lbs.

To Belgian Congo: Beef carcases, 71; mutton carcases, 10; pork carcases, 25; veal carcases, 2; offal, 1,490 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa: Corned beef, 331,008 lbs.; beef paste, 146 lbs.; tongues, 450 lbs.; sausages, 1,785 lbs.
To Northern Rhodesia: Meat meal, 51,000 lbs.

B. L. KING,
for Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-40.

Monthly Report No. 92. July, 1940.

The Red Locust (*Nomadacris septemfasciata*, Serv.).—Reports received during July refer to four winged swarms only, the districts involved being Lomagundi, Mazoe, Insiza and Melsetter.

Two of the swarms were described as "large" and two as "medium."

The paucity of the reports may be due to inactivity on the part of the insects on account of the cold weather.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA
Agricultural Journal

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Editorial

Notes and Comments

Jubilee.

There is little doubt that in happier circumstances the Journal would have devoted a good deal of its space to the Jubilee, to the rise of agriculture in fifty years, to the incredible development—in a short period of time—that spread homesteads and fertile farms across the heart of the dark Continent. The story of the Pioneers is an epic that has been told before, but cannot be told too often. The insuperable difficulties of the earlier settlers, the plagues and pests and heartbreaking disappointments that came thick upon them could never drown the call of the land, nor could they overwhelm the spirit of the men who founded this country.

In a simple and moving ceremony at Rhodes statue in Salisbury on September 12th later generations paid homage to the men who made the story of Rhodesia possible. Perhaps what they have seen recently of the spirit of the country more than repays them for all they endured.

In any event the Journal would like to add its voice to the deep gratitude of the country.

Mr. A. H. Maxwell.

In Great Britain tobacco has joined the list of commodities which are subject to Government control, and particular interest for Rhodesians attaches to the appointment of the

Tobacco Controller, Mr. A. H. Maxwell. Better known as " Sandy " Maxwell, the new Controller is familiar to overseas planters and growers, and particularly to the Rhodesian industry. As a partner of the English firm of Messrs. MacMillan, Maxwell and Co. and as a connection of the local buying firm of Messrs. Maxwell, Siemssen & Co., he visited Salisbury on several occasions as a tobacco buyer. Mr. Maxwell's duty now is to keep an eye on stocks and ensure even distribution. Clearances of leaf from bond are restricted from August onwards to 90 per cent. of the corresponding monthly amounts of last year. This restriction is believed to be mainly designed to check withdrawals for storage rather tnan for manufacture.

Organic and Inorganic Fertiliser.

A discussion by C. N. Acharya in *Indian Farming* follows his reminder that a century ago the publication of Liebig's famous "Applications of Chemistry to Agriculture and Physiology" ushered in an era of mineral, inorganic fertilisers, and the neglect of the age-old practice of organic manuring. Later experience and research during the last 30 years, particularly in India, have shown to an increasing degree the need for maintaining a proper level of organic matter in the soil if its fertility is to remain unimpaired. Present-day practice aims at combining the advantages of both systems by returning to the soil as much farmyard manure, compost and other natural manures as can be obtained and using artificials as supplements in order to obtain peak yields.

In the temperate and colder climates where the soil contains a good percentage of organic matter and the rate of oxidation is slow, the return of the root system of the crop to the soil may be sufficient to supply the necessary decaying organic matter for microbial activity and for the production of phyto-hormones, and to maintain the soil in good physical condition. But it is a different matter in the tropics where the soil contains barely 1 to 2 per cent. of the organic matter, and the rates of decomposition of added organic matter is very rapid. The return of the root system alone is insufficient under tropical conditions and additional quantities of bulky organic matter in the form of farmyard manure, compost or green manures have to be added almost every year.

Rhodesian Wheat.

A recent issue of the Economic and Statistical Bulletin of Southern Rhodesia contains numerous statistics of the wheat growing industry of the Colony. The later figures are concerned almost entirely with winter wheat, as owing to the prevalence of rust during the rainy season there is little incentive to farmers to cultivate wheat as a summer crop. In 1923 the yield of winter wheat was 11,362 bags, in 1924 it was 5,471; last year it was 52,354. This yield has only once been exceeded, in 1936. The yield per acre varies considerably from year to year according to growing conditions, in every district the yield per acre on irrigated lands being higher than, and frequently more than double, the yield per acre on vlei lands. During the years 1937-39 approximately half the number of wheat growers cultivated 25 acres or less, while about a quarter grew less than 10 acres. In this period about three-quarters of the total average planted consisted of moisture-retaining vlei land. In 1939 the non-irrigated area was 13,584 acres as compared with 3,584 acres under irrigation. In 1939 Charter remained the most important wheat producing district. The largest percentage increases in yield, however, occurred in Chilimanzi and Salisbury. The other principal wheat areas in order of importance were Gutu, Mazoe, Victoria, Ndanga and Melsetter.

Rhodesian wheat, which is mainly of a soft or semi-hard varietiey is, in general, unsuitable for the manufacture of flour unless mixed with other harder varieties, large quantities of which are imported annually. In 1939 29,003,935 lbs. of wheat were imported.

The preliminary estimate of the 1940 crop, depending on the absence of late frosts and other unfavourable events, foreshadows a record yield. The estimated number of growers has declined but the estimated acreage under wheat has increased.

The estimated yield per acre, if attained, will constitute a record for the Colony.

A Possible New Fertiliser Material.

A practically water-soluble and non-hygroscopic form of potassium metaphosphate can be obtained by the action of phosphoric acid on potassium chloride. Analyses made in accordance with the Official Methods of Analysis of the Association of Official Agricultural Chemists of America for citrate-insoluble phosphoric acid and for potash in mixed fertilisers indicate that, owing to the solubility of this metaphosphate in ammonium citrate and oxalate solutions, the phosphorus and potassium are readily available to plants. Vegetative tests support this conclusion. The high nutrient concentration of potassium meta-phosphate (39.87 per cent. potassium oxide (K_2O) plus 60.13 per cent. phosphoric oxide (P_2O_5)) should permit important economies to be made in bagging, handling, shipping, storage, and tax charges per unit, and thus make it particularly well adapted to economic distribution over wider areas than other fertiliser materials.

The Banana.

An article by H. R. Barnell on "The Banana in Relation to Human Nutrition," which appears in the August issue of *Tropical Agriculture,* would seem to suggest that the banana might be more extensively grown on those Rhodesian farms where conditions are suitable, if only for the purpose of supplementing the diet on the farm. The banana in the past has suffered from an unjustifiable belief held by many that it is an indigestible starchy fruit. Actually the well-ripened banana contains a small proportion of easily digestible starch, much sugar, some protein and a certain amount of hemicelluloses. In some cases of chronic indigestion very ripe bananas have been found to be the only source of carbohydrate that could be tolerated. In addition the banana is a rich source of energy, ranking higher than the potato: excluding dry cereals it is amongst the cheapest energy-providing foods available. The relatively low amounts of protein and fat in the banana, however, render it unsuitable as a sole source of food.

While the banana cannot be considered rich in any particular vitamin it contains A, B1, B2 (or G) and C in reasonable quantities; the antirachitic vitamin D is present in small amount only. There is little information available concerning vitamin E. With regard to minerals it has been stated that all the iron in the banana is in a completely available form.

The virtues of the apple in the diet have long been appreciated, but the banana is, on every count, a more valuable fruit. It is an unusually hygienic food due to its relatively thick and resistant skin; it has a higher mineral content and a higher calorific value, weight for weight, than the apple, and its protective food (vitamin) content is more diverse and is greater for those vitamins common to both fruit.

The banana is a valuable food for local consumption because of its high yield of food and energy per acre. It has been stated that its yield during a year can exceed that of any other crop.

South African Fertiliser Supplies.

The probability of a grave shortage of fertilisers as a result of the war is suggested in an interim report of the Industrial and Agricultural Requirements Commission in South Africa, the report of which was released on June 12th. The Commission, which was appointed last January to go into industrial and agricultural requirements generally, was asked to provide an interim report dealing with items of special importance in the present emergency. The report which was written before the invasion of Holland and Belgium points out that the Union was largely dependent for superphosphates on Holland, and for potash on French supplies shipped through Antwerp. A footnote, added after the invasion of the Low Countries, points out that the cessation of imports from these sources has taken place, and the Commission now recommends that steps should be taken immediately to obtain supplies of phosphatic fertilisers from the United States. In regard to fertilisers generally, the Commission recommends a number of enquiries, notably into South Africa's phosphate reserves, the practicability of increasing the production of ammonia in the Union, the advisability of installing additional plant for the manufacture of sulphuric acid from pyrites, and the building up of potassic fertilisers. These proposals are endorsed by the fertiliser manufacturers in South Africa, especially as Italy's entry into the war will increase their difficulties. Considerable quantities of phosphate have been imported from North Africa for working up in the Union, but as much of this comes from regions under Italian control it is obvious that this source of supply has dried up. The attitude towards the utilisation of South African phosphate is not hopeful, as previous investigations have shown this to be inferior. All efforts will be made to maintain the output of the factories, but it does seem that for some time to come there will be a very serious shortage of essential fertilisers in the Union.—*The Fertiliser Feeding Stuffs and Farm Supplies Journal.*

Seed Wheat Association.

At the annual meeting of the Rhodesia Wheat Growers' Association on the 31st August, 1940, the formation of the "Rhodesia Seed Wheat Association" was approved, with the same Executive Committee as the Rhodesia Wheat Growers' Association, with which it is affiliated. This is in the nature of an historic event, as this is the first Association of its kind in Southern Rhodesia. The Seed Wheat Association will undoubtedly exercise a markedly beneficial effect on the wheat-growing industry of the country, of the progress of which figures are given elsewhere. Some of the objects of the Association may be of interest to readers as indicating the scope and the purpose of the Association's activities. The chief object is the supply to farmers of sound and reliable seed wheat under the guarantee of the Association in respect to purity, trueness to variety, breed character and germinating capacity. The examination of wheat intended for sale will be done in consultation with, and under the general supervision, and instruction of the Department of Agriculture. It is hoped eventually to certify by a mark, under Government regulation, that approved seed is virile, true to type, and free from any serious disease. The Association will for a particular locality determine inspection standards for varieties of wheat offered for sale; it will assist members to dispose of their wheat, will promote the more general use by Rhodesian farmers of certified seed and will provide members with information as to the best methods of production of seed wheat. To these ends every member will keep a record, on a form to be approved, of the history and breeding of all seed wheat grown by him.

Tobacco Seed.

A package of tobacco seed has been lying for some considerable time in the chemical laboratories of the Department of Agriculture. The only label included with the package was "Canadian Bonanza Sundown, 1½ lbs.," and no name, address or instructions were given. Would the owner please communicate with the Chief Chemist?

"Liberty of thought is the life of the soul."

(But Cleanliness Aids Insect Control).

Letters to the Editor.

MAIZE STORAGE.

The Editor, RHODESIA AGRICULTURAL JOURNAL.

Dear Sir,

The article in the Journal on the storage of grain prompts me to send a description of my granary, which is just a hut, with 9 inch brick walls, laid in dagga, with no reinforcement, and with a cement floor and roof.

To make the roof, an ordinary one, it was first made of light gum poles, placed close together, with reeds laid over the joints, and on this a 3 inch layer of concrete was placed. The end of the rafters rested on the middle of the wall, so that when the concrete was laid it was flush with the outside thereof. The laths, or mbariro, used for tying the rafters together served to hold the concrete from slipping down while still wet, a start being made at the top.

When the concrete had set hard it was covered with thatch, to keep the granary cool, and to shoot the water off the wall, which was tarred outside, and plastered inside with the grey subsoil from a sandy vlei. The manhole was made in the wall, at the top, and a door was made to fit it; when the bi-sulphide of carbon has been put in this is plastered thickly all round with dagga, and the whole thing made air tight.

On the cement floor three layers of broken bricks were placed, and the joints were filled with dry sand. The grain is poured on this, and when taken out there is no sign of dampness down to the last mealie. Mealies have been kept in this granary for two years in perfect condition. It is about 12 feet diameter inside, the wall is about 8 feet high, and the capacity is about 150 bags.

It might have been better to have reinforced the wall with a strand of barbed wire, but the solid cone of concrete on top seems to make it unnecessary.

The whole thing is absolutely effective, no mode of construction could cost less, and to all appearance it will last indefinitely.

I should be pleased for anyone interested to call and see it; my place is three miles from Marandellas on the road to the Ruzawi School; Dr. Hopkins and Mr. Marshall know it. It would be well, however, for any intending visitor to let me know beforehand, as I am away from home a great deal.

Yours faithfully,

J. H. FINCH.

Marandellas, September 16th, 1940.

"LACK OF SUCCESS IS LARGELY THE RESULT OF NEGLECTED OPPORTUNITIES."

The Headyoke in Ox Transport.

METHOD OF USE AND POSSIBILITIES.

By MARTIN TRACEY, Newbiggin, Chakari.

The headyoke is by no means a new discovery—it has been employed in Europe for centuries, though not, strangely, in Great Britain. The outstanding feature is that the whole pull is taken on the forehead of the beast instead of on the hump. The yoke is of spring steel with a specially padded cushion for the comfort of the ox. There are two firms manufacturing headyokes in the Union, but the two types really only differ in mode of draught, although there is slight variance in the actual headyokes themselves. One headyoke pulls on two chains from a swingle, which in turn is hooked onto a whipple-tree, after the manner of harnessing horses. The whipple-tree is fixed to the central trek chain, while an ordinary neck yoke with a very long "trens" keeps the oxen coupled and the trek chain at the correct height. This is fairly near the ground, so as to keep the point of draught low.

The other make of yoke is similar, except that long chains and swingles are replaced by short chains attached to a steel-tubed neckyoke which bends over the humps. Here there is only one central trek chain which fastens onto the middle of the bent neckyoke with a normal-length "trens."

Once the oxen are accustomed to headyokes there is no sign of discomfort, and it very rarely seems as if they are even pulling. The saving in oxen is an important feature. Two oxen in headyokes should do the work of three or four in neckyokes. Another but less important point is the saving of a "voorlooper" when cultivating—two cultivators work in adjacent rows, with one ox to each, coupled together by an ordinary neckyoke. Only one native of the two behind the cultivators need be a driver; the other can be unskilled.

An interesting observation in my own experience is, that although my oxen have been ploughing two to two and a half acres per day per three furrow disc plough, there is no sign of any falling off in condition.

Inspanning.—At the start of the first trek the headyokes are put on and are fastened by straps round the bases of the horns. Care must be taken when training oxen that sores do not occur where horn and skin meet. If a sore does start, however, it may be alleviated by a liberal pad of cotton wool under the strap, provided no dirt gets between wad and sore to cause further chafing.

The oxen are inspanned first into neckyokes and then the chains are hooked onto the headyokes. On outspanning at mid-day the headyokes are left on the oxen and this greatly facilitates inspanning for the second trek. It is perhaps advisable to have a reim over the beast's back preventing the traces from dropping when turning at headlands, and thus eliminating, more or less, the chance of the chains getting caught up in beasts' legs; but I find that even without the rein, my oxen rarely get entangled sufficiently to cause noticeable delay.

The other type of headyoke mentioned is, of course, much simpler for inspanning, the method being almost the same as with the old neckyoke. The headyoke in this case, however is not safely left on the oxen at mid-day.

The number of oxen required per three-furrow plough is anything from six to ten, according to the character of the soil, but in normal cases eight should be ample. I am using ten, as I like them to step out well. But it is impossible to dogmatise on the number of beasts required to pull such-and-such an implement without full knowledge of the facts relating to each case. It must obviously depend on the heaviness of the soil, the implement, the depth of working, and a host of other factors. It can only be stated that a great reduction is achieved by the use of headyokes.

It may be necessary to put the headyoke on some oxen in the race for the first few times, but this is not a discouraging sign, as there are generally the beasts that will pull well from the start.

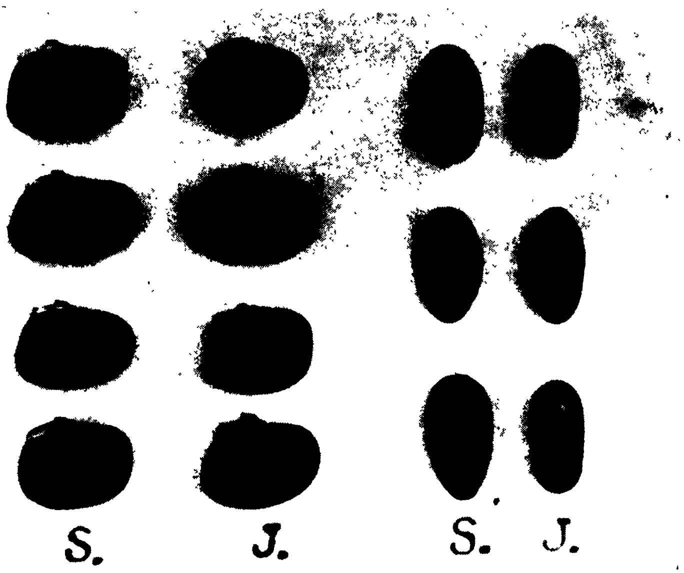
The main difficulty lies, however, not with the animals but in the conservatism of the native driver. My own had to have the promise of a considerable reward when they should have eight oxen pulling a plough before they would give the necessary enthusiasm to the work. Once they get used to it, the trouble is over and they begin to see the possibilities.

The cost of the outfit is probably the most deterring factor, being from twenty-five to thirty shillings per ox, according to whether home-made swingles are used or the Boughton steel neckyoke. But the price becomes trivial when you remember that a headyoke, unlike an ox, cannot die on you. If, after several years of service, the pad starts to come undone, a competent saddler can renew it quite inexpensively.

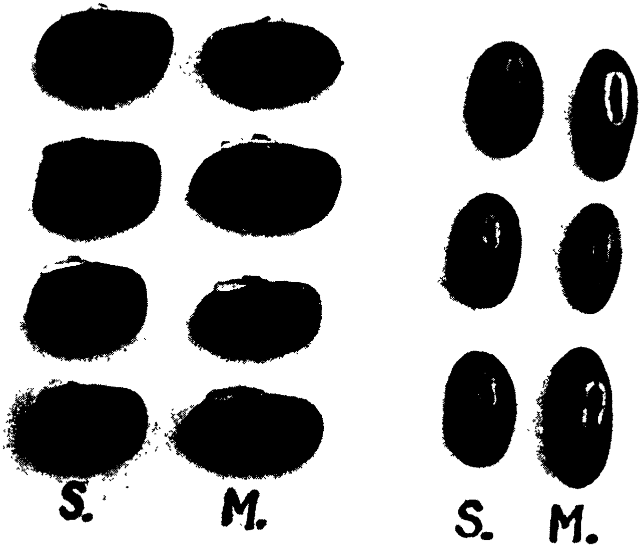
Oxen working in headyokes can be seen at this farm, but I should like notice of an intended visit.

Opportunities for agricultural cleanliness are always at hand.

Cleanliness Aids Insect Control.



Velvet Beans.—S = Somerset; J = Jubilack.—The latter variety has black seeds and these are thinner than Somerset seed. Because of this 25 per cent. less seed (by weight) is required for sowing.



Velvet Beans.—S = Somerset; M = Marbilee, whose seed is more elliptical in shape and thinner in section than the Somerset seed. The normally putty coloured ground may be tinged red or tawny and it is marbled with dark brown markings; 25 per cent. less seed (by weight) is required for sowing.

New Strains of Velvet Beans.

By H. C. ARNOLD, Manager, Agricultural Experiment Station.

During the past ten years or so the "Somerset" variety of velvet beans has increased in popularity to such an extent that scarcely any other kind is now grown on the farms in this Colony. It is favoured because of its heavy yields of vines and seed as compared with those of the older varieties, coupled with its ability to resist drought and excessive rains, rusts and insect pests so that it can always be relied on to yield a crop, however adverse the season may be. Nevertheless, in common with all the varieties of velvet beans, when considered as producers of hay, it has one great drawback, *viz.*, numerous fleshy seed-pods which require some four weeks or more for drying before the hay can be safely gathered together and stacked. Many farmers have found to their cost that, through gathering it before the pods were thoroughly dry, their hay has developed mouldy patches which have rendered it unpalatable or even quite unusable. On the other hand, if the hay had been left in the field for a longer period, it might have got leached by rain and have been reduced in value for that reason. It is obvious, therefore, that a plant which possesses all the good qualities of the Somerset velvet bean without its fleshy pods would be a valuable asset to the stock feeders of this Colony.

Another variety of velvet bean named *Stizolobium aterrinum* was eventually received which produced abundant crops of vines. It seemed to be the ideal kind, but it was found to produce such a small quantity of seed that it was uneconomical to grow. It required a very long growing season and was killed by the frost before it had time to mature its seed. It was recognised that if a strain could be evolved which would mature later than Somerset, but early enough to produce a crop of seed sufficiently large to permit of its economical propagation, it would be of greater value than the Somerset variety. With this object in view crosses were made between the varieties Somerset and *S. aterrinum*. Eventually about six hundred strains were isolated and grown in separate plots. Many of these were discarded after the first season's trial. A large proportion were found to possess spikey hairs similar to those found on the wild "Buffalo" bean, and had to be discarded for that reason in spite of being heavy producers of fodder. Plots of the Somerset variety for comparative purposes have been included in these trials each season and any of the new strains which seemed inferior to it have been excluded from the following season's trial. In this way the strains under trial were reduced to forty for the season 1938-39, and further reduced to thirteen last season, when all of them produced heavier crops of vines than the Somerset variety. It is thought that considerable confusion might be caused if several strains were issued whose seed would be difficult to distinguish, and so it is proposed to limit the number issued to farmers to two strains which are definitely distinct from one another in addition to being superior to the older variety. The seed coat of one of these has marbly markings similar to those of Somerset, while the other is a black-seeded variety similar to the other parent.

As it is the Colony's Jubilee year it is proposed to use compounded words to commemorate the occasion and also to describe their seed colour. The marbly-seeded strain will be called Marbilee and the black-seeded strain Jubilack.

Marbilee.—In comparison with the Somerset variety, the Marbilee strain has much more numerous and finer vines; seed-pods begin to form about two weeks later, but the majority form three to four weeks later. The difference in the weight of vine growth varies in different seasons between 50% and 100% in favour of Marbilee; but the Somerset variety usually produces the most seed, though, in the season just past, Marbilee's seed production equalled that of the older variety.

It is seen, therefore, that the new strain produces heavier crops of fodder suitable for use in the form of hay or silage, and that, provided it is sown early in the season, it yields almost as much seed as the Somerset strain. The crop can therefore be sown at about the same low cost per acre. When the crop is to be used as hay, it is advisable to delay sowing until the middle of December in order that the fodder may be free of large seed pods at the end of the following April, at which time good hay-making weather may be expected. When the crop is intended for the production of seed, it should be sown as early as possible. It may be sown "dry," before the rains break, if the precaution is taken to cover the seed with three inches of soil in order to ensure that germination does not commence until sufficient rain has fallen to sustain the growing plantlets.

Jubilack.—The main differences between this strain and Marbilee, in addition to the seed colour, are the longer growing season, deeper green and coarser vines and leaves, and also a large proportion of vines and a correspondingly smaller crop of seed. Nevertheless, a seed crop which is only half as large as that of the Somerset variety, is large enough for economical propagation. In the strain trials here it has been sown before November 15th each year, so that the plants could germinate as soon as soaking rain had fallen, and even though it has started growth so early in the season, its seed crop has not been sufficiently mature to harvest until the following July or August. It will be seen, therefore, that the seed production would be very adversely affected if the crop should be killed by an early frost, and this strain is not very well suited to districts which are subject to early frosts, excepting when the crop is utilised as hay or silage. When the seed germinates in the beginning of December, the formation of seed pods is so much delayed that the crop can be used as hay as late as the beginning of the month of May. Tobacco farmers and others, who have no labour to spare for side-crops during the summer months, would find this a very suitable variety, because its seed could be sown before the planting out season arrives, and apart from a few harrowings to keep down the weeds, the crop would require no further attention until pressure of work with the main crops had passed.

In comparison with Somerset, the yields of this strain were as follows:—

Season 1938-39: Vines 108% more; seed 71% less; total crop 20% more.

Season 1939-40: Vines 76% more; seed 25% less; total crop 22% more.

It was suggested that the fodder of the new strains might be found to contain more fibre, and therefore be less digestible than that of the Somerset variety, because through continued growth, over a longer period, the first growth might become old and tough. It has not been possible to make strictly comparative analyses, but it is interesting to compare the amounts of protein found in the velvet bean fodder after preservation as silage, grown in our "Protein Production" trials. The percentages of protein given below are calculated at 100% dry matter.

Season.	Variety of Velvet Bean.	Protein per cent.
1937-38	Somerset	14.7
1938-39	Somerset	14.2
1939-40	Mixed new strains	17.26

These results indicate that growers of the new strains need not anticipate any diminution in the quality of their fodder as a result of changing from the old variety. On the other hand, it appears that the increase in the proportion of vines to seed pods has raised the protein content of the fodder in addition to rendering it less difficult to cure.

The formation of early seed pods has not been entirely eliminated from these strains, but as they are definitely heavier croppers than the standard variety, and a high standard of genetical homogeneity is not very necessary in a side crop, it is thought that the interests of our farmers will be better served if they are released at once, rather than withhold them for a further period in order to effect small improvements.

There are small quantities of seed of both strains available for issue to farmers of this Colony, but as that of the Jubilack strain is very limited, it can only be issued to farmers in districts which experience only very slight frosts. Applications should be sent to the Agriculturist, Department of Agriculture, Salisbury.

The Conditions Governing the Hire of Government Boring Machines.

By Major C. E. GOAD, M.C., Boring Superintendent.

The conditions under which farmers and other private applicants may obtain the services of the Government drilling machines for the purpose of boring for water are defined in the water Act, 1927, as amended by the Water Amendment Act, 1938. Regulations for the Hire of Government Drills for Water Boring, etc., are published in Government Notice No. 458 of the 29th September, 1939.

Copies of these regulations are obtainable on application to the Director of Irrigation, P.O. Box 387, Salisbury, or the Irrigation Engineer, P.O. Box 566, Bulawayo.

The following fuller details regarding certain sections of these regulations are published for general information. Applicants in the past have sometimes complained that regulations of this nature are not sufficiently self-explanatory and that they do not know what their commitments are likely to be if the services of one of these machines is obtained.

Charges involved (Section 21).—Charges for the drill are on a daily and not footage basis, a day being reckoned as a 9½ hour working period. The cost involved in hiring one of the machines comprise:—

(*a*) A charge of £3 per day whilst the drill is being set up or dismantled and for carrying out a pumping test (12 hours or under).

(*b*) A charge of £6 per day whilst actually boring or while essential operations in connection therewith are in progress. This includes inserting, withdrawing or perforrating casing and dressing of bits.

(*c*) A charge of £5 per day for any delays due to the applicant not supplying fuel, water or transport.

(*d*) The cost of casing put down to line the borehole; the cost of casing varies according to prices prevailing at the time, but may be taken to range from 5s. per foot for 5 inch, 6s. per foot for 6 inch, and 11s. 6d. per foot for 8 inch diameter casing.

(*e*) Where one borehole only is drilled on one application, an applicant will be charged a minimum sum of £50 in respect of such charges as are detailed under sections (*a*), (*b*) and (*c*) of Section 21.

(*f*) A charge of 10s. per day is made in the case of drills driven by internal combustion engines. In the case of a drill equipped with a tractor a charge of 10s. per mile will be made to move the drill to the applicant's site.

Average Costs.—The list of charges detailed above appears formidable, but in actual fact the boring costs do not, on the average, amount to a considerable sum, and are cheaper than sinking wells to a corresponding depth in similar formation. The only cases in which complaints are received as to the high cost of boring are those where more than one borehole has had to be sunk on a property before a supply is obtained.

The total footage drilled for private applicants since drills have been powered with crude oil engines has amounted to 18,814 feet, at an average cost of 14s. 10d. per foot, including the price of casing supplied, but excluding fuel, water and transport. This footage represents 148 boreholes which have been sunk for private applicants, of which 85 per cent. have yielded useful supplies of more than 2,500 gallons per day at an average depth of 125 feet.

From this it will be seen that the total cost per borehole is under £95, and it will be admitted that if all boreholes could be guaranteed to be sunk for this figure, there would be no cause for complaint. Unfortunately, however, there can be no guarantee of this nature as the costs vary considerably in different formations, and during the period in question the costs for individual successful boreholes have varied from

7s. 7d. per foot to 34s. 4d. in extreme cases. In the majority of cases it is safe to assume that the cost per borehole will not exceed £150, including costs of fuel and transport.

Method of Payment (Section 3).—There are six methods by which payment of the boring charges may be made, *viz.*:

(*a*) By payment of a cash deposit of £75 and such additional sums as may become due during the progress of operations.

(*b*) By payment on demand of the full amount after completion of the work. Security required being two personal sureties who are holders of immovable property in Southern Rhodesia.

(*c*) By payment of monthly instalments over a period not exceeding two years. An interest charge at the rate of 5 per cent. per annum on any outstanding instalments from due date to date of payment and any balance outstanding at the expiration of such period until the amount due is paid in full. Security as in (*b*) is required.

(*d*) By payment of a cash sum on completion of the boring operations and the balance by instalments under same conditions as (*c*).

(*e*) By an advance from the Land Bank. In these cases applicants have to submit a certificate from the Manager of the Land Bank stating the amount of the advance that has been approved.

(*f*) By an advance from Irrigation Loan Funds (applicable only to farmers). An applicant who wishes to take advantage of these facilities should make application on a separate form for a loan to cover the estimated cost of the boring charges, the necessary forms being obtainable from the Irrigation Department.

These loans are granted normally subject to 4½ per cent. per annum interest charges and are repayable in annual instalments, the period of redemption varying from 5 to 10 years, dependent on the amount of the loan. The first annual instalment is usually called for about a year after the completion of the work.

The security required for an irrigation loan is either two personal sureties who are holders of immovable property in Southern Rhodesia, or failing that, the loan will be registered against the title deeds of the farm at no extra expense to the applicant.

All applications for irrigation loans have to be approved by the Governor-in-Council.

Classes of Government Drills. (Section 13). The standard equipment at present supplied consists of combination drills, the percussion or jumper portion for boring through soft formation and the rotary shot equipment for boring through hard rock. Either type may be brought into operation as required. All drills in present use are driven by internal combustion engines. There are three types of drills. Single unit, double unit and double unit with tractor.

The Director of Irrigation reserves the right to send whichever type of drill is the most convenient.

Transport (Section 15).—The single unit require one span of 14, and 1 span of 8 oxen and two wagons with full teams of oxen to move the drill, caravan and equipment.

The double unit as above, but with extra team of 14 oxen.

Double unit with tractor. The applicant will not be called upon to supply transport, but a charge of 10s. per mile will be made.

If the applicant can supply motor transport consisting of not less than a 3-ton lorry fitted with tow hitch, short moves can be carried out in a reasonable time, but for moves covering a distance of more than 8 miles would require not less than one 3-ton and one 5-ton lorry, providing the roads and gradients are reasonably good. Drills and caravan are mounted on pneumatic tyres.

Speed of travel by motor vehicles is not to exceed 8 miles per hour.

Fuel and Water.—Sufficient fuel and pure drinking water is to be supplied by the applicant for the use of the drill foreman and native staff, as well as wood fuel or coal for dressing bits.

During boring operations a quantity of water is required to operate the drill, approximately 350 gallons per diem for percussion drilling and up to 1,600 gallons per diem for shot drilling. Practically any quality of water can be used for this purpose, providing it does not contain too much mud or silt. The plant is provided with square tanks of 200 gallons capacity, which can be conveniently carried on a wagon or lorry for conveyance of water from source of supply to the drill.

Geophysical Prospecting and Rebates.—Application for the hire of a Government drill must be accompanied by an application for geophysical prospecting together with a cheque for £2 2s. (made payable to the Accountant, Division of Agriculture and Lands), and Schedule A completed. In the event of boring being undertaken on the site selected the deposit will be deducted from the boring account. A site selected by this means assures the applicant that, in the event of a supply not being developed, his application for a rebate will be recommended. If no favourable site is selected and the applicant still wishes to bore he must sign a form agreeing not to apply for a rebate.

In cases where boring operations have been carried out in terms of these regulations (458 of 29th September, 1939), on a site approved by the Director of Irrigation and which have been unsuccessful in the developing of a water supply, an application for a rebate of the actual charges under section (21) paragraphs (*a*) and (*b*) up to a maximum of 75 per cent. of such charges will be considered. Applications for rebates should be made upon receipt of the account showing boring charges.

No rebate will be considered if a yield of 50 gallons per hour has been developed on an urban residential plot or industrial stand.

Rebates would be recommended for farmers, providing the applicant does not limit the area on which the site might be selected and supplies developed yield less than 200 gallons per hour.

No rebate will be considered if the applicant wishes to bore in the bottom of a well, and all applicants are advised against this practice.

General.—An application for the hire of a drill and geophysical survey must be made on the prescribed forms.

Since the charges are based on a daily rate it is in the applicant's own interest to render all assistance possible for the expeditious carrying on of the operations.

The drill foremen are instructed to submit their weekly reports to the applicant for signature before forwarding them to the Irrigation Division, and applicants are advised to satisfy themselves that the information contained therein is correct. No discussion as to their accuracy can afterwards be considered.

The Farm Home

Food

By Miss E. E. Coutts.

"Nutrition is the foundation of Public Health."

Some years ago bad health was considered a misfortune which had to be endured as best it may, but modern science has proved that if the world had a more general knowledge of the underlying principles of healthy living more than half the ills to which we are heir need never occur.

The science of nutrition is one of the most important aspects of this principle of health. When a man decides to take up any branch of stock farming his first care is to study the subject of the feeding of his animals from a scientific point of view in order to get healthy animals at a reasonable cost. The whole success of his farming depends on this. Yet that same man and his wife will bring up a family without any attempt to study the problem of human feeding.

A great national responsibility rests on women, as the prosperity of a nation depends on the mental and physical fitness of its citizens; and this depends almost entirely on proper nutrition. During time of war this presents a greater and more vital problem than ever. Food is limited and costly and a diet has to be devised using the minimum amount and yet giving all that is required.

Nature has provided in a child some warning signs which tell whether or no his food is "doing him good." If food is unsatisfactory the child does not grow or put on weight—in time sickness may develop. There is no sign in the adult other than "that tired feeling," discontent, gloom and irritability, general nervous disorders, or the opposite—cheerfulness and content. On occasions there may be some more definite sign and we state such and such an article of food did not agree with us. As a rule this is not the case, there has been some other cause. The majority of us can eat the average diet of any country without any "indigestion." Any well-chosen all-round dietary is satisfactory for adults. "Well chosen" is an important term, as modern economic conditions give a limited choice, owing to the cost, and in addition manufacturers may destroy or refine away very important constituents. It is not always the highest price which will produce the best food.

From the above it will be seen that every housewife should have some knowledge of up-to-date scientific feeding.

Food is required in the body:—

1. To build and repair all tissues.
2. To produce heat and nervous and muscular energy.
3. To regulate all processes of the body.
4. In certain cases to protect.

No one food is perfect in providing all that is required nor can one food be rated more highly than another. All have their uses and a perfect diet can only be obtained by mixing the various imperfect foods so that the defects of each are made good by others, hence the need for a good all-round mixed diet.

Each food is made up of numerous foodstuffs required by the body and a certain knowledge of the composition of foods is necessary.

The following is a simple classification of the most important foodstuffs required by the body with their more important uses:—

Foodstuff.	**Work.**	**Sources.**
1. PROTEIN...	(a) to build and repair all tissues. (b) to give heat and energy (of secondary importance as it is an expensive source)	Meat, fish, eggs, milk, cheese, cereals, pulses, nuts.
2 CARBOHYDRATES (starches and sugars)	to give heat and enegy	Sugar, fruit, honey, milk, cereals, pulses, vegetables.
3 FAT	(a) to give heat and energy (b) to protect delicate organs	Cream, butter, fat of meat, milk, cheese, eggs, vegetable oils, cereals, nuts.
4 MINERAL SALTS	(a) to make bones and teeth (b) to keep blood in good condition (c) to aid growth	Milk, green vegetables, fruit, eggs, cheese, fish.
5. WATER	(a) to keep temperature even (b) to remove waste matter (c) to make the body fluids (d) to dissolve and carry food to all parts	Water, milk, fruit, vegetables, beverages, etc.
6. VITAMINS	(a) to help growth (b) to maintain health (c) to prevent or cure certain diseases	Vegetables, fruit, liver, milk, animal fats, eggs, cereals and most common foods, particularly uncooked fruits and salads.
7. ROUGHAGE	(a) to prevent constipation (b) to regulate the bowels	Fibrous parts of fruit and vegetables, cereals

N.B.—The sources are placed as much as possible in order of importance.

A diet should include meals which contain something from each of the above sections. It is most important that balance between the various constituents should be correct.

The diet has been considered from the point of view of a healthy normal person, but it might be interesting to note in which directions an ill-chosen diet may have an adverse influence upon health.

Kind of Diet.	Result.
1 Inadequate in quantity, otherwise satisfactory.	Malnutrition.
2 Over adequate.	Obesity and may result in certain diseases developing owing to organs overworking.
3 Adequate as regards heat-producing substance, but deficient in certain essential constituents. (Cheap diet of too much starch).	War or nutritional œdema or certain deficiency diseases from lack of minerals and vitamins.
4 All constituents present but badly balanced.	Too much fat habitually produces kelosis and acidosis. Too much calcium upsets absorption of phosphorus.
5. Unsuitable with regard to too little or too much roughage.	Indigestion, constipation or diarrhœa may develop.
6. Food contains poisonous substances through contamination.	Definite poison symptoms.
7. Certain agents lacking.	(a) Determines resistance or response to disease (particularly in children, e.g., dental decay, rickets). (b) Pernicious anæmia and numerous other diseases.
8. Diet sometimes satisfactory for ordinary individual, but quite unsuitable for the exception.	Certain people cannot eat strawberries, apricots, etc.
9. Dietary deficiencies.	These link up with endocrine disorders, e.g., goitre.

It should be stressed, however, that an adequate mixed diet containing green salads and uncooked fruit every day will usually produce satisfactory results without any difficulty.

Farming Calendar.

NOVEMBER.

CITRUS FRUITS.

If no appreciable rain has fallen, irrigation must be resorted to in order to keep the trees in good growth and to prevent any check to fruit development. This is a good month to plant green crops. Sunnhemp is possibly the best crop to smother weed growth and supply humus-forming material after it is ploughed in. If not already done, storm drains should be made on the sloping ground to prevent erosion of the surface soil during heavy storms. Where new plantings are contemplated, the holes should be dug and everything got in readiness for planting if the trees are ready for lifting in the nurseries. All unthrifty trees could with advantage have an additional amount of fertiliser and manure applied during the month. Keep down all water shoots.

CROPS.

Take note when the first rains fall, and see what leaks there are, if any, in the farm buildings. Do not neglect to effect such repairs as are necessary. Early in the month see that the planters are in perfect order, and that they drop the different seeds to be planted evenly and at the right distance. Try them out on the farm road. Hasten the work of getting the lands for early sown crops into as good a condition for seeding as possible, so that the first and most favourable opportunity for planting may be seized. The young plants make more rapid growth in a good seed bed. Utilise exceptionally early rains for this purpose rather than for planting. The holes for check-row planting of maize can continue to be prepared until sufficient rain has fallen to allow of planting. Velvet beans and dolichos beans for seed or hay may be planted dry if the land is in good order. With favourable weather, planting the maize, velvet and dolichos beans and cotton will commence about the middle of the month, and will continue as the condition of the land and the rainfall permit. Main crop potatoes should be planted from now on to January. Dhal may be planted for seed or green manuring —if for seed, a frost free situation is necessary. Kaffir corn for seed may be planted this month. Green-manure crops requiring a long growing season should be planted. Destroy, by feeding or burning, early planted trap crop of maize or volunteer plants which have become infested with stalk-borer.

If weeds are beginning to show, keep the harrows going in front of the planters. If weeds are too advanced to be killed by drag harrows and too numerous to be dealt with by hand labour, use the disc harrow or lightly re-plough the land. If the tilth is good, do not be afraid to harrow the young maize. This will save much labour later on by destroying the weeds while they are small.

DECIDUOUS FRUITS.

Continue thinning out fruit on the trees if a very heavy setting has occurred. A small amount of large-sized fruit is preferable to a large crop of small fruit. Thin down the inner growth of new shoots if they have a tendency to crowd each other, and stop all suckers and main stem growths as they appear.

FLOWER GARDEN.

All seeds may now be planted. Annuals for January flowering should be sown, amongst which the following will be found to be excellent in this Colony: Balsam, Calliopsis, Centurias, Chrysanthemum, Dianthus, Escholtzia, Marigold, Mignonette, Gallardia, Phlox, Poppy, Nasturtium, Nigella, Verbena and Zinnia. These are all hardy, and may be sown in the open either in beds or in the position desired for flowering. Advantage should be taken of each shower of rain during this month to keep the soil well worked and loose.

VEGETABLE GARDEN.

All vegetable seeds may be sown during this month. Tomatoes and early peas and beans should be staked. The soil should be kept loose and free from weeds, which now get troublesome. Sow pumpkins, mealies, peas and potatoes.

FORESTRY.

Sowings of eucalypt (gum) seed should be made for late planting. If fresh seed of cedrela toona is available, sowings should be made. Keep the seed beds moist and free from weeds. The tap roots of early seedlings may be cut back in order to form hardy, stocky plants most suited for planting. Continue with pricking out if transplants are to be used. Prepare all land to be planted by cross-ploughing and harrowing. A well prepared soil is a good fertiliser; it assists establishment and reduces failures.

POULTRY.

Some birds will now be commencing to moult. This will cause a decrease in the number of eggs laid. The poultry keeper, therefore, should see that his birds come through the moult as quickly as possible. Some birds will lay and moult simultaneously, but these are the strongest, most vigorous and the best layers; the majority do not. The process of moulting is a natural one, but it is a severe strain on the system. Fowls that are not too fat, and can stand extra feed at the commencement of the moult, come through it best. More green and animal food should be given, and the utmost care taken that they are not exposed to cold or wet, otherwise they will not only take longer to moult, but go off in condition. A little linseed stewed, or linseed meal, or ground nut meal and milk should also be given. There will next month be a demand for table birds, and such as the poultry keeper intends to sell should be selected. In making this selection, it is no use choosing old or scraggy birds, for it is hopeless to attempt to fatten these, or make them good table birds. Do not coop them up till a fortnight or so before they are to be sold; give them free range and feed them well, with at least one feed of soft food mixed with milk once a day. Turkeys destined for the Christmas market should have free range, but also a feed of soft food once a day, and a good feed of mealies in the evening.

STOCK.

Cattle.—Normally rains should have fallen and the veld should be plentiful now. Beyond careful dipping, ranchers should not have much worry. If the season is bad, the poorer cattle should be drafted out and given a little hay, ensilage or maize daily. The grazing should be improving rapidly in feeding value. If normal rains have fallen, the grass should be sufficient for cows of average production. Heavier milkers should be fed concentrates at the rate of about 3 lbs. per gallon of milk produced over the first. In most cases maize meal alone will be sufficient for the purpose.

Sheep.—Dip sheep; put the rams to the ewes; keep the sheep on high dry land; be sure the kraal or sheep shed is dry and clean, and that there is shelter from the rain for young lambs.

DAIRYING.

In a normal year veld grazing should be plentiful in November, and the feeding of dairy stock is then very much simplified; veld grass in a green and succulent condition is practically all that is required for animals of less than average production. Heavy milking cows, however, on early pasture, require extra feed in the form of concentrates, while the latter should always be fed to dairy stock which are in poor condition at this time of the year. Young calves should not be turned out to graze with the herd, and in wet weather are best kept in a clean, dry, airy pen. Weaned stock, which have not hitherto had access to green pasture, should be gradually accustomed to the change in diet and may at first be turned out to graze for short periods. Young stock on pasture should also receive a small daily allowance of concentrates.

Farmers supplying cream to the creamery should adjust the cream screw to the separator so that the latter will separate a cream testing 45 to 50 per cent. butter fat. Cream of this consistency will keep better than thinner cream. It should be borne in mind that it is practically impossible to produce first-grade cream if the cattle are milked in a muddy kraal. In the absence of a cow shed, every endeavour should be made to erect a small milking shed in which four or five cows can be tied, milked and fed. A small shed of this kind is also essential to obtain clean milk for cheese-making. Milking in a muddy kraal invariably results in a gassy, bitter cheese being produced.

The shelves of the cheese room should be scrubbed with boiling water and soda, and for the last rinsing a weak solution of formalin may be used. This should prove effective in controlling cheese pests.

TOBACCO.

Continue to sow seed beds, watering, etc. When early beds become overgrown and hard, pull out, dig up and re-sow. Begin transplanting with the first good rains, and continue as fast as the rains and planters will allow, until the crop is set out. Be careful to fill in the misses from previous transplanting before starting on new fields; use the stoutest and best plants for filling in, and try to get the tobacco from any one field to grow and come to maturity as near at the same time as possible. Discontinue filling in when the field has been planted for several weeks and has made a good start to grow, as the later filled in plants will be choked out by the earlier ones, and will not come to maturity. Cultivate fields as soon as plants are established, to keep down weeds.

VETERINARY.

Early heavy rains might bring on horse-sickness before its usual time, but as a rule it need not be feared till the first rains are over in December.

Soya Beans.

NOTES ON CULTIVATION.

By H. C. Arnold, Manager, Salisbury Experiment Station.

The undesirable features of previous strains of soya beans which made their successful cultivation on a large scale a difficult matter, appear to have vanished in the new strains which have been tried out at the Salisbury Experiment Station. The most important of these is Potchefstroom No. 184. The growth of soya beans in Rhodesia, with special reference to soil and rainfall conditions, time of sowing and harvesting, is discussed in the following pages, together with notes on bacterial inoculation, yields, marketing and the place of the soya bean in crop rotations and the farm economy generally. The soya bean is a valuable food: although the costs of growing would be higher, the marketing costs would be lower than those for maize.

These notes on soya bean cultivation are being written in response to numerous requests for information from farmers who wish to grow this crop for the first time.

As the crop has not hitherto been widely grown in this Colony, little experimental work has been done, excepting for the introduction and trial of new varieties. As these varieties differ very widely in habit and height of growth, period to reach maturity, colour and size of seed, it will be readily understood that the cultural methods most suited to certain varieties will not be the best for others.

Numerous varieties have been introduced by the Department of Agriculture and by private persons, but only a very few of these have yielded heavily enough to justify cultivation on a large scale, and in addition, all the former introductions have a tendency to scatter their seeds within a few days of their becoming sufficiently mature to permit of the crop being harvested. It was also found that plants on certain areas would ripen several days before the plants on adjacent areas only a few yards distant, although all were of the same strain and had received exactly the same cultural treatment. These undesirable characteristics have been overcome to a large extent by the plant breeding work carried out by Dr. Saunders at the School of Agriculture, Potchefstroom, and we now have a number of strains whose pods do not dehisce until some thirty or more days after the majority of the leaves have turned a yellow colour and fallen from the plant, which indicates that maturity has been reached and harvesting operations may be commenced. This non-dehiscent or non-shattering characteristic has removed one of the main disabilities which formerly prevented the large scale cultivation of this crop, because it allows the work of harvesting to be postponed until more urgent work has received attention, and for patches whose ripening has been delayed, to reach a stage of maturity sufficiently advanced to allow the whole crop to be reaped in one operation. Thus the employment of labour-saving machinery for every operation connected with the cultivation of the crop is made possible.

The varieties may be classified under two heads, namely, those whose seed is suitable for manufacturing purposes and others whose heavy yields of fodder make them eminently suited for use as hay or silage, although their seed may not be suitable for milling for human consumption.

Varieties for Milling.—As a general rule, only those with light coloured seed coats—usually cream to creamy-yellow—are acceptable to the milling trade, and only such should be grown when it is intended to market the crop as grain. In variety trials made at this Station, one known as Potchefstroom No. 184 has produced heavier yields of grain than previous non-shatter introductions. A number of strains bred at this Station have out-yielded No. 184 in our preliminary trials, but at the present time our stock of seed of these is not sufficient for large scale sowings.

There are also several other strains which have been sent out from Potchefstroom, and it is possible that some of these may be equal to No. 184 for cultivation in other parts of this Colony.

It may be mentioned here that in the Transvaal the yields of No. 184 were exceeded by other strains, and its cultivation there was discontinued. For this reason it is not possible to obtain seed from beyond our borders, and the amount within the Colony at present is limited to a few bags.

A few farmers have reported good yields with other non-shattering strains, whose seed was obtained from a commercial house. Such strains may be almost as valuable as our best, but if the name or place of origin is unknown its value as seed is greatly reduced.

For example, ten strains, all of which originated at the School of Agriculture, Potchefstroom, were included in our variety trials in the season 1937-38. The best yielder (No. 184) produced 1,300 lbs. per acre, and the poorest only 510 lbs. per acre. It will be seen, therefore, that the economic success or failure of the venture may depend entirely on the variety sown, and how important it is for prospective growers to obtain the best strain available and to remember its name or distinguishing number, so that, when they have seed for sale at a later date, they are able to guarantee its value.

It may be mentioned here that Potchefstroom No. 51, which is one of the best varieties for cultivation in the Union of South Africa, yielded 20% less seed in trials conducted at this Station than Potchefstroom No. 184.

Soil and Rainfall Conditions.—A summer rainfall which ranges between 25 and 35 inches, and is evenly distributed, suits the moisture requirements of this crop. Although soya beans can grow and produce partial crops under soil conditions which are either too dry or too wet for maize, as a general rule, the soil conditions best suited to maize are also the best for soya beans. The texture of suitable soils ranges between loamy sand and clay, and those which are slightly alkaline or slightly acid, produce equally good crops. However, extremes should be avoided. Soils which are shallow, wet and cold, decidedly alkaline or acid, hard crusting clays and sterile sands are all quite unsuitable.

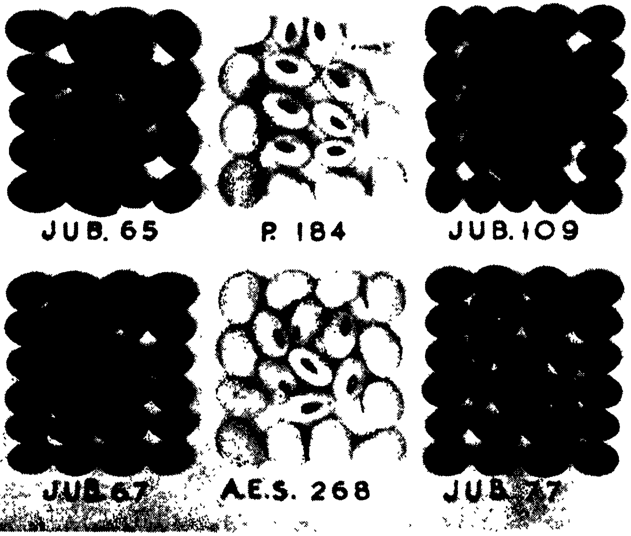
The humus content of the soil appears to be of great importance. In the season 1938-39, when unusually wet and cold weather was experienced, the growth of the soya beans on this Station was noticed to be much more thrifty on certain parts than on others, although previous treatment had been the same. Samples of soil from these areas were analysed by the Chief Chemist's branch and it was found that although all the samples contained practically the same amounts of inorganic plant foods, those which had produced the heaviest crops of soya beans contained a little more humus than the others. The lack of sufficient humus had reduced the crop by 75% in some cases. Farmers are advised, therefore, to refrain from planting this crop on soils known to be deficient in humus.

It is well known that in the case of maize lands, the ploughing under of vegetable matter which is only partially rotted may reduce the grain yield of that crop, because the micro-organisms which cause the decay of the vegetable material rob the maize plants of the nitrogen in the soil. The growth of the soya bean is not depressed in that way, because it obtains nitrogen by means of the bacteria which it shelters in nodules on its roots. It appears to benefit also through the presence of vegetable matter in the soil, and this suggests that the crop may require conditions suitable for the development of mycorrhiza on its roots as well as the nodule forming bacteria, because on soils deficient in humus, growth is sometimes found to be sub-normal in spite of satisfactory nodulation. A sufficiency of phosphate is also necessary. A dressing of 100 lbs. to 200 lbs. per acre should be applied if the soil is lacking in this respect.

Date of Sowing.—Generally, the heaviest crops are obtained from varieties which require the longest period of growth. It is not advisable to sow before the rains commence, because the seed cannot survive conditions which are unfavourable for germination. The latter part of November and the first half of December is the most favourable time for sowing our heaviest producers, but sowing may continue until the end of December or later, at the risk of reaping reduced yields if the rainy season is curtailed.

Seed Sowing.—The drilling machines used for maize and also those for wheat can be adapted for soya beans. In America a large part of the crop is sown with grain drills which place the seed in rows eight inches apart, and over 100 lbs. of seed per acre is sown. The spike harrows and rotary hoes subsequently used to weed the crop reduce the stand somewhat. For Rhodesian conditions the best distance between the rows has yet to be determined. In distance-planting trials conducted at this Station last season, where the distance between rows was 24 inches, 18 inches and 12 inches with a uniform spacing of 4 inches in the rows, the average yields from six replicated plots were four and a half, five and five and a half bags per acre respectively. Hence the closest spacing gave the highest yields, but the difference between the twelve inch rows and the twenty-four inch rows is only one bag, and when the extra cost of the seed, drilling and weeding is taken into account it is doubtful whether the close spacing would be found to be more profitable than the wider one. For maize farmers who wish to use the same machines for both crops, the most convenient spacing will probably be thirty inches between rows, but for those who have suitable types of machinery for dealing with rows more closely spaced, a distance of 18 to 24 inches between rows may be found the most economical. Close drilling is favoured by some authorities because the canopy formed by the plants reduces weed growth. On the question of spacing in the rows some interesting information is found in Bulletin No. 462 published by the University of Illinois entitled "Eleven Years of Soybean Investigations." It is stated that in rows 24 inches apart the seeding rates investigated ranged from 32 to 147 pounds per acre. The average yields of seed over a period of five years showed a difference of little more than 100 pounds per acre. Seeing that there was so little difference in the yield, whether the spacing in the rows was 1½ inches or any other distance up to six inches apart, it would seem that this point is not of major importance. At Illinois, over a five-year period with rows two feet apart, the heaviest average yields were obtained when 50 lbs. to 70 lbs. per acre were sown. These amounts would produce a stand of 11 to 15 plants in each yard of the row. When the seed is hand-planted the spacings employed at this Station are 4 inches and 6 inches. The wider distance is used for the robust, hay types, and the closer for the dwarf yellow-seeded types. Under field conditions when the rows are to be 24 inches apart, if the drill is set to sow the beans from three to four inches apart, a stand which will average about nine plants to each yard of the row will be obtained. When the distance between the rows is 30 inches or more, the drill

Soya Bean, Jubiltan No. 65, and Velvet Bean sown together for hay. The soya props up the vines of the other bean and enables the crop to be cut with a mowing machine.



Soya Beans.—Differences in size, shape and colour of the various strains. A.E.S. 268 is slightly kidney shaped and thinner than Potchefstroom 184. Both are suited for human consumption. The Jubiltans are the best for cattle and for fodder production.

should be set to drop the beans at two to three inches apart in the rows, in order to compensate for the wide distance between rows. Thus some 40 lbs. to 50 lbs. of Potchefstroom No. 184 will be required for each acre sown.

Depth of Sowing.—Care needs to be taken to ensure that the seed is not sown either too shallow or too deep. One and a half to two inches is the best depth, and on no account should the depth exceed three inches. On soils which tend to form a crust after heavy rain, shallow seedings about one inch deep and dropping two or three seeds together in hills instead of sowing in a continuous row will help to ensure a good stand. The use of depth regulators attached to the furrow openers, similar to those recommended for cotton planting, may be found necessary on loose soils.

Weeding.—The rate of growth of young soya beans is slower than that of maize, and this makes it imperative that early and effective measures should be taken to destroy the weeds before they compete with the beans for the soil nutrients and moisture. By preparing a good seed-bed and destroying all weed growth immediately before sowing, the necessity for further weeding, until the plants are well above ground, may be avoided. It may then be found possible to use weeders or light harrows without seriously reducing the stand, provided the surface is free from trash left over from the previous crop. Thorough weeding during the early stages of growth is of great importance in order that the crop may quickly outgrow the weeds. Later the canopy formed by the beans checks weed growth.

Harvesting.—The crop can be harvested before the leaves have all fallen off, and as soon as the seed has reached the hard-dough stage. When harvesting machinery is employed, it is imperative to reap before the stalks and seed are thoroughly dry and tie in bundles. When risk of mildew development is past, these are bunched in shocks or stooks of convenient size and left until they are well dried, after which they may be stacked until it is convenient to thresh them. The erect growth of the plants enables them to be harvested with the same kind of machines as are commonly used for wheat. Some varieties have a tendency to form their pods rather too close to the ground to allow the reaping machine to be used without leaving a portion of the seed attached to the stubble. The remedy for this will be the choice of a naturally tall growing variety, and favourable soil and cultural conditions. Small areas could be cut with a mowing machine, but when this is employed, a sufficient number of labourers should be on the field to collect and tie the crop into bundles and move them out of the path of the machine, so as to avoid trampling on the beans by the draught animals on the next round. Reaping machines which also bind the crop into bundles could be used to advantage. In America it has been found that machines which combine the operations of reaping and threshing reduce the cost of harvesting to one-half of that incurred when the operations of cutting, binding, stooking, loading and hauling the bundles, and threshing are performed separately. Before combine harvesting can be practised in Rhodesia it will be necessary to make sure that the crop can be economically produced, and that varieties are available which will ripen uniformly over large areas and retain their seed for a sufficiently long period to allow the machinery employed to operate for a period of some few weeks. In the meantime the reaping and threshing machinery already in use on the maize and wheat farms in this Colony can be adapted to deal with soya beans. Manufacturers of many types of threshing machines now supply the equipment needed for effecting the necessary adjustments for threshing soya beans.

Yields.—As with other crops these vary considerably, and are affected by the variety, the suitability of the soil, the care given to the cultivation of the crop and seasonal climatic conditions. From 700 lbs. to 800 lbs. per acre could be expected as an average for well attended farm crops, though yields as high as 1,800 lbs. per acre have been reported by farmers who have grown them on small patches of fertile land. A useful comparison may be made between soya bean yields and maize yields. During the past season Potchefstroom No. 184, sown 20 inches by 4 inches apart, yielded 807 lbs. of seed per acre, compared with approximately ten bags of maize per acre on the adjacent land. The same variety produced 1,300 lbs. per acre on land which yielded 18 bags of maize per acre in the previous season. The spacing in this case was 24 inches by 4 inches, and no manure or fertiliser was applied to the soya bean crop, though it probably benefited from the residue of a dressing of kraal manure applied to the previous crop of maize. It appears, therefore, that the yield of this variety of soya bean, when grown under favourable cultural conditions, may be estimated at approximately one-third of the yield of maize grown under similar conditions.

Market Prospects.—Past experience has shown that a crop may yield remunerative returns while it is being grown for local consumption, but as soon as the local demand is amply supplied the price 'slumps and difficulty in disposing of the surplus is experienced. For the immediate future a market exists in the Union of South Africa, where soyas are being used in several ways, but chiefly to fortify the maize meal rations of the natives who are employed in the Rand mines. Exhaustive experiments proved that the natives who received a ration which had been strengthened by the addition of 10 per cent. of soya bean flour, were able to perform their tasks in a more efficient manner than other groups of natives who were fed on various other rations which did not include soya flour. The merits of this fortified ration is being recognised by other enlightened employers of native labour, and in spite of a rapid increase in the production of soya beans within the Union itself, several hundred tons have been imported from the East to cope with the demand this year. There is every reason to expect that a local market will also be created for these beans as soon as it is found that they can be economically produced and their valuable nutritive qualities are recognised by employers of labour and feeders of livestock. When more than enough to meet local demands are being produced, it would appear that little difficulty is likely to be experienced in finding an outlet for our surplus. The merits of this bean as food for humans, particularly as a substitute for eggs and meat, because its proteins contain adequate amounts of all the known essential amino acids, is being increasingly recognised in all the European countries. The slaughtering of farm animals in Europe at the present time will eventually create a demand for meat substitutes, and as soya beans can be produced more economically than other beans and can be used in the place of animal proteins and fats, there is every reason to think that, when hostilities cease, if not before, the

European markets will be able to absorb larger quantities than are likely to be produced in Southern Africa for several years to come. The distance from Manchuria, the main source of Europe's present supply, is approximately twice as far as from Beira to Britain, so the difficulty of obtaining sea freightage which is likely to continue for several years should also be a factor in our favour.

Soya beans are chiefly valued for their protein and oil. The tabulation below shows how they compare with other widely used farm crops and with good quality beef. In this tabulation the protein and oil content given for soya beans is the average amount yielded by nine new strains now under trial at this Station. The yield of the ground nuts is based on a twenty bag per acre crop of nuts which would yield about 900 lbs. of kernels.

	Yield per acre lbs	Crude Protein %	Ether Extract Oil %	Crude Protein per acre lbs.	Oil per acre lbs
Soya Bean	800	39.8	17.2	318	138
Maize	2,400	9.3	4.7	223	113
Wheat	1,400	11.7	2.0	164	28
Ground Nuts . (kernels)	900	30.8	47.1	277	424
Pasture	200 (beef)	18.0	16.0	36	32

In the tabulation above only the protein and oil contents are considered, because these are of much greater importance to our oversea customers than carbohydrates. At the present time Britain can obtain practically all the carbohydrates she requires from other sources, which are much nearer to her ports than Beira. The tabulation shows that one bag of soya beans contains as much protein and oil as four bags of maize, and that one ship loaded with soya beans could carry as much of these essential nutrients as four ships loaded with maize. This indicates that, after providing for local requirements, our farmers could perform their part in the war effort more effectually by growing four bags of soya beans per acre than twelve bags of maize for export.

While a twenty-bag crop of ground nuts would yield nearly as much protein and three times as much oil as a four-bag crop of soya beans, difficulties of transportation constitute a serious drawback with this form of produce. The local market could absorb much larger amounts of proteins than are available at present. Although ground nuts are grown in the Colony, large quantities of ground nut cake and other protein-rich cattle foods are being imported. Our manufacturers of ground nut products find that although the protein the nuts contain is much in demand, they have a surplus of oil which is difficult to dispose of. It is seen, therefore, that the proportions of protein and oil in soya beans would suit local requirements much better than those found in ground nuts, and it is thought that a part of our ground nut crop could very well be replaced by soya beans.

It has been mentioned that soya beans can be used as a substitute for animal proteins. Pasture land, from which 200 lbs. of beef per acre per annum is obtained is considered highly productive, and yet that amount of high grade beef contains only 36 lbs. of protein and 32 lbs. of fat. Thus the product of an acre of land under soya beans will contain about as much protein as can be obtained from eight acres of improved pasture when it is converted into beef. In other words, an acre under soya beans will produce approximately as much protein and half as much fat as that contained in three carcases of Imperial grade steers which together weigh 1,800 lbs. If the vegetable proteins in the soya beans have the same nutritional value as the animal proteins in beef, then pound for pound soya beans are worth two and a half times as much as beefsteak; though, of course, this extra value may not be appreciated by those who are accustomed to the flavour of fleshy foods and find pleasure in eating them.

Production Costs.—The per-acre cost of growing soya beans would be somewhat higher than it is for maize. Better preparation of the seed-bed; 2 to 3 times as much seed; closely planted rows requiring more hand weeding than rows widely spaced; reaping and threshing both more laborious unless combine harvesting could be practised. Thus all operations connected with the cultivation of this crop would be somewhat more costly than they are with the maize crop, and it is thought that the cost of growing wheat would approximate that of growing soya beans more closely than the cost of growing maize. On the other hand, marketing should cost less, because fewer bags and less haulage would be required.

Market Values.—As with other crops, these are subject to fluctuations. At the present time beans for milling are worth between 17s. 6d. and 20s. per bag of 200 lbs. in the local market.

Place in the Crop Rotation.—Being a leguminous crop, soya beans are very suitable for inclusion in a rotation in which maize is one of the chief crops. On a certain plot on this Station soya beans and maize have been grown in alternate seasons for some eight years. Although no green manure or humus dressing in any form has been applied during that period, a satisfactory crop of maize was grown on this land during the season just ended. In spite of these results, the writer would not recommend the general adoption of this system, but it does indicate that, instead of green-manuring the land every third or fourth year it might be found possible to extend the period between the applications of green-manure without reducing the cropping ability of the land. There is no doubt that the soya bean crop has a beneficial effect on the maize crop which follows, but whether it is equal to sunnhemp in this respect is a matter for investigation. Tobacco farmers should note that most varieties of soya beans are highly susceptible to eelworm attack.

INOCULATION WITH SPECIFIC BACTERIA.

It is well known that all leguminous farm crops live in symbiotic relationship with certain kinds of bacteria whose activities on the roots of the plants result in the transformation of the free nitrogen of the air to a form in which it can be utilised by the plants, and is highly beneficial to them. The particular kind of bacteria favoured by the soya bean is not usually found in Rhodesian soils. For this reason when this crop is first grown on the land it is advisable to inoculate the seed to obtain the desired benefit from their activities. If the majority of the plants are found carrying the bacterial nodules, it will not be necessary to inoculate that land again, provided the interval between soya bean crops is not more than three or four years.

No investigational work designed to ascertain the longevity of these bacteria has been done in this Colony, but in America, after a period of eighteen years, virile bacteria were found in certain soils, but as a rule the number in the soil decreases rapidly after two or three years. They disappear more quickly in acid than in neutral or alkaline soils.

Inoculation may be effected through the use of pure cultures of the bacteria; these are now made in the Union of South Africa, and sufficient to inoculate a bushel of seed may be purchased for a few shillings. When soil known to contain the bacteria is available, it may be spread over new land at the rate of about 400 lbs. per acre and harrowed in or, preferably, sown through the fertiliser attachment when the seed is drilled. The soil transference method has been employed by the writer but it has not given as good results as the pure culture and seed-dusting methods.

Seed-dusting with Prepared Soil.—The soil is prepared by first steaming it in order to destroy eelworm or other injurious forms of life, and is then placed in petrol tins. To each tin some wood ash and a teaspoonful of complete fertiliser is added to ensure that enough fertility is present to support vigorous growth. Soil known to contain the bacteria is also mixed with the surface layers and about a dozen soya beans are sown. After a time a few of the beans are uprooted to ascertain that nodulation is satisfactory, and as a rule it is found that the surface layers of the soil are literally packed with nodules. By this means soil known to be rich in bacteria is obtained, and this is used to inoculate next season's seed. A heap of seed beans is first moistened with skimmed milk; failing skimmed milk a sticky medium such as thin glue or sugar solution may be used. A mixture of three parts of bacteria bearing soil and one part of rock phosphate is then sprinkled over the beans as the heap is turned over and over until every seed is partially coated with soil. Care is taken not to moisten the beans so much that their coats wrinkle. If it is found that an excess of moisture has been applied, the seed can be dried off by applying more soil and phosphate. After inoculation the beans are laid out in thin layers on sacks in a shed until they are thoroughly dry. As the bacteria are likely to be killed if they are exposed to sunlight, the inoculated beans should be kept shaded and sown with a drill whenever possible.

The method described above has been used at this Station for some few years, and the seed has been sent to all parts of the Colony, and with very few exceptions heavy nodulation has been reported by farmers who have sown it. While it is a very efficient method for inoculating the seed, and is satisfactory for use when only small quantities are being sown, the placing of soil in the planter seed boxes might prove objectionable when large quantities of seed are dealt with. For this reason it would be advisable to turn the beans over a few times and sift out the loose soil before they are planted.

A modification of this method which might prove more satisfactory for large-scale operations is the "muddy-milk" method. Skimmed milk, which has been boiled and allowed to cool, is mixed with the bacteria laden soil in equal proportions and stirred for several minutes to break up all the lumps of soil and liberate the bacteria into the milk. Allow the soil to settle and after a few minutes pour off the liquid. This may be used at once by sprinkling it over the beans and turning them over so that all are slightly moistened. Between one and two pints of liquid will be required foı each bag of seed. A little rock phosphate should be sprinkled over the moist seed. The reason for adding rock phosphate is because the bacteria cannot develop normally in the absence of phosphate. An acid medium is also harmful. As most of our soils are somewhat acid, it is a wise precaution to drill rock phosphate at the rate of 200 lbs. per acre with the seed. This fertiliser not only supplies the phosphate needed by the plants, but the lime it contains neutralises the soil acidity in the vicinity of the seed and favourable conditions for the growth and rapid multiplication of the bacteria are ensured from the start. If rock phosphate is not available, superphosphate may be used, but it should first be neutralised by thoroughly mixing it with lime or wood ash. The mixing of lime and supers is not regarded as good farming practice, because it causes the soluble phosphates to revert to an insoluble form, but it is advisable for this particular purpose, as the acidity of the supers might have a harmful effect on the bacteria.

Inoculation not only increases the crop to which it is applied, but the residues which remain in the soil have a beneficial effect on the crops which follow. If it is desired to thoroughly establish these bacteria in the soil, a dressing of lime should be given if it is found necessary to correct soil acidity, and a second crop of soya beans should follow the inoculated crop either in the first or second season.

FODDER VARIETIES.

Varieties which produce large quantities of stalks, leaves and seed, but whose seed are unsuited for human consumption, are classified under this head. The isolation and testing of hundreds of strains enabled this Station to issue the varieties named Otoxi and Biltan about six years ago. These pioneers have proved their value as fodder producers among the farmers of Mashonaland; but, like all the older varieties, they demanded immediate attention when the seed crop was ready to harvest. Through the courtesy of Mr. A. S. Laurie, of Somerset Farm, Concession, another variety was obtained which is markedly non-shattering, but as it requires a very long growing season and its habit of growth is semi-procumbent, it is not very suitable for general cultivation. Crosses were made between this non-shattering variety and the older strains, and after much testing four strains have been isolated which, in some degree, possess all the desirable characteristics of both parents, with the possible exception that they require a somewhat longer period to reach maturity than Otoxi and Biltan. It is proposed to distribute these to farmers under their experiment numbers preceded by the word Jubiltan.

In the tabulation below are given particulars regarding four strains it is proposed to issue to farmers, and the yellow-seeded Potchefstroom No. 184 is included for comparison. The figures given are averages from the data collected over three seasons' trials at this Station, but wide variations occur under varying conditions. Fluctuations occur in the growth period and size of the seed and in the protein and oil contents of the seed, as well as in the yields.

JUBILTAN SOYA BEANS *versus* YELLOW-SEEDED.

Average yields, etc., in Strain Trials.

Strain Number.	Growth Period. Days.	Yields per acre. Hay. tons.		Nutrients in Seed. Protein. %		Oil. %	Colour.	Seed. Number in 1 lb. ±250	Rate of Sowing, lbs. per acre. Drills. 36"x3"	
			Seed. lbs.		per acre					24"x3"
65	145	3.25	1,100	44.6	491	13.9	Black	3,000	21	32
67	148	3.25	1,000	45.1	451	13.5	Black	4,100	15	22
77	160	3 75	1,100	42.4	466	14.1	Black	4,300	14	21
109	155	2.75	1,200	45.9	551	14.3	Tawny	4,650	13	19
P.184.	110	2.00	1,100	36.5	402	17.5	Yellow	2,000	30	44

The information given in this tabulation shows that, although the yellow-seeded variety is the best to grow when the crop is produced for milling for human consumption, the Jubiltan strains are much superior to it as producers of fodder for feeding to farm animals. For instance, No. 77 yields nearly twice as much hay, and the seed grown on a certain area will re-sow more than twice as much land as the seed produced by the yellow-seeded variety on a similar area. Furthermore, small seed germinates better than large seed, particularly on land which forms a hard surface crust. The reason for this is probably because during the process of germination the whole of the bean seed, excepting its skin, is pushed up above the surface of the soil; hence small beans offer less resistance to the soil covering than large beans and so a larger proportion of the small-seeded kinds pass through this initial process successfully. In addition to heavier yields of stalks and leaves, the seed has a considerably higher percentage of protein than Potchefstroom No. 184, and pound for pound has a higher nutritional value.

Rate of Sowing.—Owing to their abundant growth as compared with that of the yellow-seeded kinds, a lighter seeding may be given, particularly when seed production is the object in view. On fertile land rows 30 inches to 36 inches apart and 3 inches to 6 inches in the rows is the best distance when the crop is required for seed, but for hay the rows should be closer; from 18 inches to 30 inches between the rows and 3 to 4 inches in the rows will be found an economical distance. Broadcasting is less satisfactory than drilling, because the depth of covering cannot be regulated, but if necessity demands this method of sowing, 60 lbs. to 80 lbs. seed per acre should be used. Broadcasted crops may be weeded with light spike harrows until the bean plants are 8 inches high, choosing the hotter part of the day for that work, because the stems are then less turgid and not so likely to be snapped off.

Growth above ground is rather slow at first, presumably because the small seeds of these varieties—No. 65 excepted—do not provide as much food material as the larger seed of the yellow kinds, combined with their need for the development of a larger root system to support the larger growth eventually made. This slow initial growth makes it more important to destroy the weeds early in the season in order that the beans may extend their root systems far and wide and successfully compete with later crops of weeds.

Soya beans make good hay at any stage after the pods form and until the leaves begin to fall. Early-cut hay will probably be richer in protein, but hay cut after the seeds are well formed and before the leaves begin to fall gives the greatest total yield. The hay is readily eaten by stock at whatever stage it is cut, but they show a preference for that which is not too mature.

Soybean hay is easier to cure than most other kinds of legume hay. Several farmers have found that their soya bean hay remained unharmed after being exposed to rain for some few days, whilst velvet bean and cowpea hay produced on adjacent land and subjected to the same treatment had been completely ruined. Although soya hay may be discoloured by the rain and its nutritional value reduced, its palatability is not impaired and cattle eat it greedily. Stockmen who have used it over a number of years say they consider it to be as good as lucerne or even better.

Retention of Seed in the Pods.—The number of days given below during which the seed was retained by the pods represent the longest periods found possible to leave these strains after 50% of the leaves had fallen, without incurring loss from "shattering." Climatic conditions are largely responsible for variations in the length of this period. Dull weather is favourable to seed retention. Soaking rain followed by drying wind causes the pods to open and cast their seed, so that if rain occurs after the leaves have fallen it is advisable to reap the crop as soon as possible after fine weather sets in. If the crop is reaped, tied into bundles and stooked, very little loss from shattering will occur, even if it is left in the field for some few weeks.

The chief distinguishing characteristics of these Jubiltan strains are as follows:—

Jubiltan No. 65.—Erect, sturdy habit of growth similar to Biltan but it requires two weeks longer to reach maturity and its pods retain their seed for about 14 days after half the leaves have fallen. Farmers who wish to grow mixed crops of soya beans and kaffir beans or velvet beans for hay, should use this type. Its sturdy growth props up the vines of the other beans, and so permits a mowing machine to be used to reap the crop. In order that the soya beans may obtain a lead over the other crop, they should be sown in drills 36 inches apart three to four weeks ahead. The seed of the trailing bean may either be drilled after the crop of weeds has been destroyed, or alternatively broadcasted and covered by the cultivator used to destroy the weeds which make their appearance between the rows of soya beans.

Jubiltan No. 67.—Erect, branches long and fine. Similar to No. 77, but it matures earlier than that variety and is better for late sowing. Pods retain their seed for 24 days after the leaves have fallen.

Jubiltan No. 77.—Erect habit, branches fine long and numerous. Its yields of fodder have exceeded those of the many other strains included in our trials. It is considered to be the best of the Jubiltan group provided it is sown early and grown under favourable conditions. Retained seed for 18 days.

Jubiltan No. 109.—Erect habit, branches fine and long. Retained seed for 16 days. Its fodder yield is somewhat less than that of the other strains, though its yield of seed is the heaviest of all the strains so far tested. Farmers who require hay of very high quality, and those who wish to grow soya bean seed for feeding direct as their cattle would find this to be the best strain to grow as the seed is exceptionally high in protein. It is practically equal to ground nut cake in nutrient value. The colour of the seed varies with its age. New seed is yellow brown with a green tinge, but the brown colour becomes more pronounced with advancing age or exposure to sunlight. The high yield and small size of the seed enables the grower to sow some fifty acres or more with the seed grown on one acre.

Although these strains are each derived from a single plant, they are not genetically "pure," but as they are definitely superior to the older strains, it is thought that the best interests of the farming community will be served by releasing them at once, instead of retaining them for a further period with the object of increasing their homogeneity.

Among new yellow-seeded strains under trial are some which yielded 20% more than Potchefstroom No. 184 during the past season. These include strains whose habit of growth make them suitable for fodder purposes. Thus, although their fodder yields would be somewhat less than that of the Jubiltan strains, the grower would have the advantage of postponing his decision as to whether the crop should be used as hay or as seed to be sold for milling, until after the vagaries of the season are known.

SUMMARY.

The introduction of strains of soybeans which yield good crops of seed and also retain their seed in their pods long enough to allow a reasonable period for reaping, appear to make the cultivation of this crop economically possible.

The choice of a variety suited to the district is of the utmost importance. Potchefstroom No. 184 is the best yellow-seeded and the Jubiltan strains are the best fodder varieties we have, but seed supplies of these are at present very limited.

Rainfall and soil conditions suited to maize are the best for soya beans also.

Both maize planters and wheat drills can be used for sowing this crop. Seed requirements are 40 to 50 lbs. of the large-seeded and 15 to 20 lbs. of the small-seeded kinds, per acre. Twenty-four inches between rows and 3 to 4 inches in the rows may be considered as standard spacing for the yellow-seeded kinds, but the distance between rows may vary from

8 inches to 30 inches if compensating differences are made in the spacings between plants in the rows. Depth of planting should be between one and two inches and on no account exceed three inches. Bacterial inoculation of the seed is advisable when the land is sown for the first time.

Early and thorough weeding is imperative.

Harvesting may commence when the seed reaches the hard-dough stage. The stalks should be tied in bundles and stooked as soon as they are dry enough. The machines used for threshing maize and wheat can be adjusted for threshing beans also.

Three to four bags per acre could be expected from fairly well attended farm crops, though twice that amount has been obtained from well manured land.

Its high protein content make it especially valuable for balancing foods of a starchy nature, and it can be used as a substitute for animal proteins in the diet of both Europeans and natives. The valuable nutrients, protein and oil, can be transported more economically as soya beans than is possible in the form of either maize, wheat, ground nuts or beef.

Although the costs of growing would be higher, the marketing costs would be lower than those for maize.

There are small quantities of seed of Potchefstroom No. 184 and the Jubiltan strains available for distribution. The Co-operative Experiment Scheme enables farmers who would like to try these strains to secure sufficient seed to sow a small patch this season, with the object of obtaining enough seed for more extensive sowings in future. In order that the stock may be increased as quickly as possible the seed issued should be sown on well manured land. It will be inoculated with the specific bacteria before it leaves this Station. Applications for seed, stating whether the milling type or fodder type is preferred, should reach the Agriculturist, Department of Agriculture, Salisbury, before October 31st.

Acknowledgments are due for the co-operation of the Chief Chemist and his staff and also to Mr. Noel le Sueur for his gratuitous services in connection with these investigations.

FIRE PROOFING OF THATCH.

A. J. Taylor, of the College of Agriculture, Cedara, in the *Union Weekly Press Service*, gives the following hints for the fire-proofing of thatch :—

One of the drawbacks of thatch in farm buildings is the risk of fire. This danger can be largely eliminated, however, if the thatch is treated before use with a suitable protective material.

Ordinary alum is one of the best and cheapest of such chemicals, whilst ammonium phosphate, sometimes applied as a fertiliser, can also be used.

The bundles of thatch grass should be loosened and then well soaked in a solution of alum, about 4 to 8 ozs. per gallon of water. When thoroughly saturated, they should be removed from the solution and the surplus liquid allowed to drain back into the tank or vessel used for treating the thatch. Standing the loosened bundles on end on a sheet of corrugated iron leading into the tank will ensure good drainage and so save any surplus alum solution. The bundles should then be spread out to dry, standing them on end against a wall or suitable rack so as to ensure a good circulation of air around and through them. It is important that the thatch be thoroughly dry before it is put on the roof. Damp thatching material employed in constructing a roof is very liable to become mouldy and to rot.

The thatch grass should be treated with the alum before it is used. It is less satisfactory to spray a thatch roof already built, since the grass does not become properly impregnated with alum, especially the inner layers to which the solution does not penetrate.

Thatch thus treated will be found to smoulder but not to burn freely. The alum which coats the grass fuses and so forms a protective glaze on the thatch which prevents access of air to the material and so makes it difficult to ignite. Sparks falling on such treated thatch will not set it alight.

The use of alum has a further advantage in that it makes the thatch less liable to harbour insects.

Rhodesian Milk Records.

SEMI-OFFICIAL.

COMPLETED LACTATIONS.

Name of Cow.	Breed.	Milk in lbs.	B. Fat in llbs.	Average % B. Fat.	No. of Days.	Name and Address of Owner.
Charleston Fanny	P.B. Friesland...	13,792.90	436.90	3.17	300	Bluffhill Dairy, P.O. Box 346, Salisbury
Betty	G. Friesland	5,828.40	224.76	3.85	300	H. V. Gibbs, Bonisa, Redbank
Pitter	G. Friesland	6,921.30	233.14	3.36	300	
Fuss	G. Friesland	7,461.00	264.39	3.54	300	
Jean	G. Friesland	6,783.20	290.37	4.28	300	
Julia	G. Friesland	6,241.90	239.17	3.83	300	
Lina	G. Friesland	6,727.40	249.43	3.70	300	
Mafuta	G. Friesland	8,363.60	373.35	4.46	300	
Pat	G. Friesland	5,764.80	229.62	3.98	300	
Bluebell	G. Friesland	6,916.30	229.74	3.32	274	Gowerhill Dairy, P.O. Box 1143, Salisbury
Della	G. Devon	4,475.10	204.61	4.57	240	
Edna	G. Jersey	7,092.70	306.47	4.32	300	
Glen	G. Friesland	5,953.20	212.70	3.57	260	
Matikana	G. Friesland	6,390.40	255.97	4.06	300	
Nyasa	G. Friesland	6,528.40	267.83	4.10	300	
Cherry	G. Shorthorn...	5,750.80	226.51	3.94	240	D. J. Huddy, Granville, P.O. Box 899, Salisbury.
Fanny	G. Friesland	6,537.80	212.86	3.26	284	
Flivver	G. Friesland	6,200.40	220.80	3.56	300	
Mnyaga	G. Friesland	6,690.00	208.09	3.11	300	
Witklap	G. Friesland	6,767.20	242.83	3.59	300	
Bella	G. Friesland	7,671.50	261.72	3.41	300	V A. Lawrence, Knockmaroon, Norton.
Elsie	G. Friesland	8,411.50	319.75	3.80	300	
No. 10	G. Friesland	10,058.50	320.23	3.18	300	Mazoe Citrus Estate, P.O. Mazoe.
No. 17	G. Friesland	7,591.50	250.14	3.30	300	
No. 30	G. Friesland	6,584.50	226.15	3.43	300	
No. 2/7	P.B. Friesland...	7,883.00	274.47	3.48	300	Meikle Bros., Leachdale, Shangani.
No. 216	P.B. Friesland...	5,899.00	208.79	3.53	204	
No. 275	P.B. Friesland...	8,476.00	322.27	3.80	300	
No. 373	P.B. Friesland...	8,859.00	310.03	3.49	300	
No. 4/7	G. Friesland	8,004.00	290.73	3.63	300	

SEMI-OFFICIAL.

COMPLETED LACTATIONS.

Name of Cow. Breed.	Breed.	Milk in lbs.	B. Fat in llbs.	Average % B. Fat.	No. of Days.	Name and Address of Owner.
No. 17	G. Friesland	9,823.00	322.35	3.28	300	Meikle Bros., Leachdale, Shangani.
No. 101	G. Friesland	10,312.00	389.48	3.77	300	
No. 165	G. Friesland	8,810.00	338.85	3.84	300	
No. 210	G. Friesland	7,011.00	250.97	3.57	300	
No. 211	G. Friesland	8,735.00	307.60	3.52	300	
No. 218	G. Friesland	8,178.00	274.68	3.40	235	
Mousey	G. Friesland	4,954.10	226.47	4.57	300	S. Moore, Nyatsime, P.O. Box 999, Salisbury.
Ray	G. Friesland	5,496.10	211 51	3.87	300	
Snowflake II.	G. Friesland	5,790.40	236.15	4.08	300	
Rose	G. Devon	5,621.50	226.31	4.03	297	E. L. Morant, Marirangwe, P.O. Box 741, Salisbury.
Violet	G. South Devon...	4,207.50	231.85	5.51	300	
Katarina	G. Friesland	4,991.60	228.08	4.57	300	W. F. H. Scutt, Maple Lea', Norton
Zakayu	G. Friesland	5,498.90	202.65	3.68	300	
Zamiwe	G. Friesland	6,640.50	239.32	3.60	300	
Amabel	G. Friesland	6,346.40	211.03	3.33	300	W. Sole, Bauhinia, Glendale.
Rebecca	G. Friesland	10.056.80	402.30	4.00	300	
Wendy I.	G. Friesland	8,358.2	288.51	3.45	300	
Amandas	G. Red Poll	4,680.40	204.50	4.37	300	J G. Thurlow, Atherstone, Bindura.
Beauty	G. Friesland	6,571.00	255.75	3.89	300	W. E. Tongue, North Lynn, Bulawayo.
Dimple	G. Friesland	7,325.00	256.29	3.49	285	
Kelpie	G. Friesland	8,620.50	306.87	3.56	274	
Jane	G. Friesland	7.004 50	236.61	3.37	328	
Jemina	G. Friesland	6,810.00	281.51	4.13	300	
Dirko Celai II.	P.B. Friesland...	5,778.00	237.57	4.11	300	Union & Rhod. Mining & Finance Co., Ltd., Quinnington, Salisbury.
June II.	C. Friesland	5,613.00	201.73	3.59	300	

OFFICIAL.

COMPLETED LACTATIONS.

Matopo Kate, 8.4.1933 ...	Red Poll	5,195.70	222.83	4.28	300	Government Experiment Farm, Rhodes Matopo Est., P.B. 19K., Bulawayo.
Matopo Nancy, 15.3.1936...	Red Poll	4,265.70	175.49	4.11	274	

PAWPAW USES.

The pawpaw is used in various forms:—

(*a*) In its ripe state as a breakfast fruit, for which purpose it is cut lengthwise into individual portions, and the seeds are removed. It is flavoured to suit the taste by addition of lemon or orange juice and sugar—or with sugar only.

(*b*) As a dessert fruit when it is sliced and eaten with sugar and crushed ice, or diced and incorporated with other fruits as a fruit salad.

(*c*) As a salad combined with lettuce or in mayonnaise; or served with green celery and onions.

(*d*) The green fruit may be boiled or baked and served as a vegetable.

(*e*) As a crystallised fruit, and it is sometimes made into pickles, marmalade, jelly, pie, jam, ice cream and sherbert.

(*f*) As the main constituent of the following commercial lines: Tropical fruit salad and pawpaw chutney.

Nearly all parts of the pawpaw have some medicinal value. The most important medical properties are said to be found in the milky juice which occurs most abundantly in the green fruit. These properties of the juice are due to the active principle called "Papain," which has been long recognised as of considerable value in dyspepsia and kindred ailments. Its digestive action is undoubted, and it is a not uncommon practice to rub a slice of green juicy pawpaw on tough meat to make it tender. Another practice is to wrap the meat in crushed pawpaw leaves over-night, preparatory to cooking it.

The pawpaw is a valuable aid to digestion, and many sufferers from dyspepsia have obtained relief by eating this fruit. Pawpaw juice contains papain, a powerful digestive ferment, which is often used instead of pepsin. The seeds have the flavour of watercress and are an efficient vermifuge.

Pawpaws contain no sucrose, but contain laevulose, which is specially suitable for diabetics.—*The Planter.*

Southern Rhodesia Veterinary Report.

AUGUST, 1940.

DISEASES.

African Coast Fever was discovered on farm "Adlams Rest," in the Salisbury native district.

Foot and Mouth Disease was diagnosed on the farms "Wankie" and "Bumboosi," in the Wankie native district.

TUBERCULOSIS.

One hundred and sixty-six cattle were tested upon importation. One cow reacted to the test and was destroyed.

MALLEIN TEST.

Four horses were tested during the month with negative results.

IMPORTATIONS.

From Union of South Africa: Horses, 3; bulls, 4; cows, 72; sheep, 1,342; goats, 2; pigs, 4.

From Bechuanaland Protectorate: Slaughter cattle, 1,251; sheep, 407; goats, 28; pigs, 5.

From South-West Africa: Cattle, 91.

EXPORTATIONS.

To Northern Rhodesia: Horses, 1; sheep, 42.

To Portuguese East Africa: Slaughter cattle, 117; bulls, 5; cows, 4.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

To United Kingdom: Beef quarters (chilled quality), 8,650; boneless beef quarters, 2,188; tongues, 13,370 lbs.; livers, 41,309 lbs.; hearts, 11,624 lbs.; tails, 9,389 lbs.; skirts, 5,008 lbs.; shanks, 7,857 lbs.; kidneys, 2,346 lbs.; fat, 3,652 lbs.; cheeks, 5,526 lbs.; tongue roots, 13,835 lbs.

To Northern Rhodesia: Beef carcases, 135; offal, 9,117 lbs.

To Belgian Congo: Beef carcases, 164; mutton carcases, 14; pork carcases, 110; veal carcases, 6; offal, 494 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa: Corned beef, 67,788 lbs.; beef fat, 500 lbs.; beef paste, 600 lbs.; tongues, 222 lbs.; sausages, 635 lbs.; tin stew, 1,920 lbs.

To Northern Rhodesia: Meat meal, 1,200 lbs.

To United Kingdom: Meat extract, 68,371 lbs.; beef powder, 10,028 lbs.

B. A. MYHILL,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-40.

Monthly Report No. 93. August, 1940.

Red Locust (*Nomadacris septemfasciata*, Serv.):

Winged swarms were reported in ten districts during August, namely, Lomagundi, Mazoe, Salisbury, Makoni, Umtali, Melsetter, Ndanga, Gwelo, Bubi and Bulawayo.

Most of the swarms were described as " medium " or small," but two were described as " very large." A loose swarm visited Salisbury township on the 4th, 6th and 13th. The locusts were all of the red migratory colouration.

No definite trend is apparent in the direction of flight as reported.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA
Agricultural Journal

Vol. XXXVII.] No. 11 [November, 1940

Editorial

Notes and Comments

Arsenic.

At any time wastage on the farm, as elsewhere, is inexcusable, but in war time it assumes the proportions of an offence. There is considerable poverty among the cattle in this country during the winter months, and the loss of condition which results is a form of wastage which the feeding of supplements might obviate. But insidious as this loss is, there is another type of loss which occurs with great regularity, though often in isolated cases, and which is very largely preventable. This is the poisoning of cattle by arsenic in dip. The two types of loss bear some relationship to each other.

Every year in the chemical laboratories toxicological samples arrive with unfailing regularity. Sometimes the viscera are from a single beast that died, sometimes they represent one of a large number. All sorts of reasons are adduced by the farmer to account for the death of his animals —strychnine, cyanide, poisonous plants and arsenic. All samples are immediately examined for arsenic, whatever the assumed cause of death, and in very numerous cases arsenic proves to be the agent. As most people know, the active agent in cattle dip is sodium arsenite, and as most people know sodium arsenite is an exceedingly deadly and virulent poison; yet, curiously enough very few people regard cattle dip as being particularly dangerous, with the result that it is often treated carelessly.

The records of the agricultural laboratory prove that every year hundreds of cattle die as a result of dip poisoning, and die incidentally, a very painful death. This is wastage on a grand scale.

The means by which the cattle obtain the dip often remains a mystery, but there is usually a quite simple explanation. They do not obtain it during their actual passage through the dip tank—that possibility may be ruled out. Sometimes they obtain it through an unfortunate chain of circumstances, but very often merely through carelessness. Spilled dip is left where it is spilled, and sometimes a native put on to clean out a drum swills it out and throws the poison wantonly on the veld. In some cases the source of poisoning is obscure: in one instance it was traced to a broken down house whose lower bricks had been treated with dip as a precaution against white ants.

But whatever the source, the cattle discover it. In many cases the cattle appear to crave the dip and there is little doubt, on the available evidence, that they do so on account of a mineral deficiency in their diet. This appears to be the only satisfactory explanation, and if it is the right one the remedy is obvious.

In the first place, extreme care should be used in the handling of dip, which is a concentrated poison, and in the disposal of drums and all objects which may have come in contact with it. And secondly, the cattle, when the feeding is poor, should have access to a salt lick, so that a salt craving will not tempt them to lick up what almost invariably proves fatal, should any dip have been unavoidably scattered on the ground.

Soya Bean Inoculation by the "Muddy-Milk" Method.

The following postscript to his article in last month's Journal is sent by Mr. Arnold:—

In the article on soya bean cultivation which was published in the last issue of this journal, it was suggested that the "muddy-milk" method might be preferable to inoculation with soil for large scale operations because soil in the planter seed-boxes might interfere with their mechanism. Since that article was written the method has been tested. Boiled separated milk was mixed with an equal quantity of bacteria bearing soil, and after thorough stirring the mixture was allowed to settle. Seed was then moistened with the milk, dried, and sowed in sterilised sand. Further quantities of seed were similarly treated at intervals of twelve hours until the sixtieth hour, when the milk was found to have coagulated. Subsequent examination of the roots of the resulting plantlets revealed a very satisfactory number of nodules on all of the treated lots, with the highest nodulation on the lots which were treated between 12 hours and 36 hours after the milk and soil were mixed.

In this trial equal quantities of soil and milk were mixed, and it was found that the greater part of the milk was absorbed by the soil and it could not be easily recovered. It is thought that two or three times as much milk as soil would be found more saticfactory, particularly if it could be mixed from twelve to thirty-six hours before the milk is applied to the beans.

Seed which had been inoculated with soil twelve months previously was also sown. All the resulting plants developed nodules but the average number was only half of that found on the freshly inoculated seed.

Importation of Plant Regulations, G.N. No. 521 of 1940.

With regard to the above the Chief Entomologist writes as follows:—

Under G.N. No. 462 of 1932, which embodies the main plant import regulations at present in force, bulbs and tubers have hitherto been exempted from the provision which requires a special permit from the Department of Agriculture for the importation of most plants into the Colony. This exemption has recently been cancelled by G.N. No. 521, 4th October, 1940, and it is now necessary to obtain a special permit to import any bulbs or tubers, other than seed potatoes and edible bulbs or tubers intended for consumption, from any place outside the Colony.

Edible bulbs and tubers include, of course, onions and allied vegetables, potatoes, sweet potatoes, etc. These are not subject to special permit under the Importation of Plants Regulations, although a permit needs to be obtained for the importation of potatoes from the Union of South Africa under the Trade Agreement.

To avoid any misapprehension, it may be stated that the importation of *dahlia* plants and tubers from the Union of South Africa has already been prohibited (G.N. No. 162, 5th April, 1940), and that no permit can be issued for the importation of tubers or plants of that genus from that country.

The above restrictions have been necessitated by the danger of introduction into the Colony of certain virus diseases, which have a wide variety of host plants, and may attack staple crops, such as tobacco, maize, etc.

Such diseases, which are commonly transmitted by insects, are liable to be introduced or otherwise distributed by vegetative portions of plants, *e.g.*, bulbs and tubers, which are used for propagation.

The disease principally in mind at the moment is the highly injurious disease of tobacco known as "Kromnek" in the Union of South Africa. This disease is officially reported to be very prevalent in dahlias, amongst other plants, in the Union. It is believed to be identical with "Spotted Wilt," which attacks a very wide variety of cultivated plants in Europe and elsewhere, including certain bulbous and tuberous plants.

There are other virus diseases known to attack certain crops, which are liable to be introduced with bulbs and tubers of ornamental plants.

The necessity for controlling such introductions will, therefore, be clear to all.

Grass in Orchards.

It has been known for many years by workers in soil science that grass is the best agent available for regenerating a depleted soil, or an overworked soil. Under tropical conditions the structure of the top soil, which is continually ploughed and in which there is much aeration and oxidation of organic matter, soon deteriorates. The soil particles become broken down and powdery and the crumb structure so desirable in soils is destroyed. In addition the carbon and nitrogen contents are very considerably depleted. Under grass carbon and nitrogen increase in the soil, a fact which has been demonstrated for Rhodesian conditions as elsewhere, and the grass roots restore to the soil its granular or crumb structure; this structure is highly resistant to erosion by wind and water and as such is, of course, desirable. These various factors, organic matter and granular structure further aid the soil by preserving its permeability, and so decreasing run-off.

Recent experiments in orchards in Pennsylvania proved that various systems of management brought about measurable differences in the carbon, the nitrogen and the depth of the top soil. Sod management, that is permanent grass, proved definitely superior as far as soil fertility was concerned, to either clean cultivation or annual cover crops, although leguminous cover crops answered almost as well. Clean cultivation without cover crops is soil depleting; it is attended by large losses of organic carbon and total nitrogen, and by destroying the structure of the soil it affects water conservation.

Naturally permanent grass in orchards introduces new problems—moisture and nutrient uptake by the cover, rodent injury, greater fertiliser requirements, and others, but it seems better to find solutions for such problems than to be forced to cope with the more difficult one of a depleted soil.

The conditions which governed these results in Pennsylvania may be expected to apply equally in Rhodesia, and there can be little doubt that permanent grass in orchards would prevent a great deal of soil erosion.

Wood Ashes.

A note from the Canadian Department of Agriculture which might be of interest in Southern Rhodesia reminds farmers that since the amount of potash that the country produces is very small it is desirable to conserve and use to the best advantage such local potash bearing materials as wood ashes.

Wood ashes should be kept under cover, for when they are exposed to rain the normal 4-6% potash is reduced to 2% or less. The largest constituent is carbonate of lime, which may amount to as much as 70% of the freshly burnt ash. Wood ashes should only be used to any extent on acid soils, and they should not be added to any excess. Analyses of the Rhodesiàn soils to which large amounts of wood ashes have been added have shown a distinct deterioration in the physical texture of the soil and a decline in productivity.

An application at the rate of 1,500 lbs. per acre of wood ashes would supply 60 to 70 lbs. potash, 600 to 1,100 lbs. of lime and 24-30 lbs. of phospnoric acid.

Electricity and Agriculture.

A technical report of the British Electrical and Allied Industries Research Association on the application of electricity to agriculture and horticulture, reveals the enormous and growing extent to which electricity is used in Britain and America. There is no aspect of farming which does not seem capable of electrical development, and the paper begins its conclusion by saying, "It is not unreasonable to expect that within a period of years, perhaps not less than 25 but certainly not more than 40, all stationary power and heating operations will be carried out electrically as a matter of course on all farms, except those which are so situated as to be out of all reasonable reach of supply." Electricity is already extensively used for motors for various types of mechanical work, for water supply, for irrigation and for power in the field for tractors and cultivators. Its use in farms and dairies is expanding rapidly and the extent to which it may be used for heating or for refrigeration is practically unlimited. Its application to incubation, sterilisation, seed irradiation, wire fencing, grain sprouting, storage and washing is being constantly investigated, and it would seem that perhaps its author's claim is justified. What seems to us the chief danger of a complete reliance upon electricity is that war, with its attendant bombing of power stations, might completely immobilise the whole industry of agriculture when it was most needed.

Star Grass.

A Union Press Service Note reports that during the last twelve months the Department of Agriculture has propagated various strains of Star Grass at one of its Pasture Stations with a view to supplying small quantities to farmers for propagation on their farms. It has, however, come to the knowledge of the Department that this grass may be toxic to animals feeding thereon. The Department has been in correspondence with authorities in Kenya and Australia to ascertain what the position is in regard to the alleged cyanogenetic properties of Giant Star Grass.

While clinical tests carried out in Australia and locally indicate that the grass is, under certain conditions at least, definitely cyanogenetic, no authentic records have come to the Department's notice of stock poisoning as a result thereof, either locally or in the countries mentioned above.

The Department, however, feels that the matter cannot be left there and it is hoped to carry out comprehensive investigations into the matter in the near future. In the meantime, issues of this grass to the public from the Department's experiment stations have been suspended and, until more definite information is forthcoming, farmers who have already established plots of this grass are being warned of its alleged toxicity and consequent possible danger to stock.

Good Haystacks must resist Weather Damage

MODERN METHODS OF STACKING.

By G. J. FIRMAN, Gaunmain.

The conservation of wheaten hay in stacks is a practice now widely adopted by farmers as a means of storing fodder for use in periods when supplementary or drought feeding of the stock is required, and it is surprising how many farmers are not really proficient in this operation. In those districts where wheat is cut and stacked prior to chaffing and a high-class product is marketed, professional stack builders are employed, but there are many properties on which the farmer or his men could store a much better product than commonly seen to-day if they understood the general principles of stack building and paid careful attention to the details of the construction work. Stack building may appear very complicated to the novice, but it is not hard to become proficient in this task.

The main consideration is that the stack should be built in such a manner that it will keep out the rain and resist weather damage. For this reason the location of the stack is particularly important, and a good, dry, level position is required where there is no danger of water running under the stack. Also, it is advisable to place the stack where there is least danger of damage by wind. Location near a good belt of timber often saves the stack from damage, and if the district is subject to westerly winds the stack is less likely to be damaged if placed with the end facing the west. Then, too, the stack should be placed where there is a minimum risk from fire.

Stacks are often built on a straddle (a platform on metal-capped posts) to give protection against damage by mice, and for the same reason a galvanised iron fence let into the ground is erected around the stack. If the stack is to be built on the ground, a good bed of straw or timber is necessary to prevent damage to the bottom layer of sheaves.

Suitable Size and Shape.—For stacks ranging up to 50 tons capacity, 6 yards is wide enough, although for greater capacities the width should be increased to 7 yards. If the stack is too wide it will have a tendency to sink in the centre when it settles, causing the outside sheaves to dip in and allow water into the stack. A stack 6 yards wide and 14 yards long with 12 feet walls will hold approximately 40 to 45 tons of hay. In a stack of this height it will be found that 2 cubic yards of hay will weigh approximately 1 ton.

A stack with a "rolled" or round end, with the walls perpendicular and a hip roof with a ridge running along the central portion of the stack, is the easiest to build and is quite satisfactory.

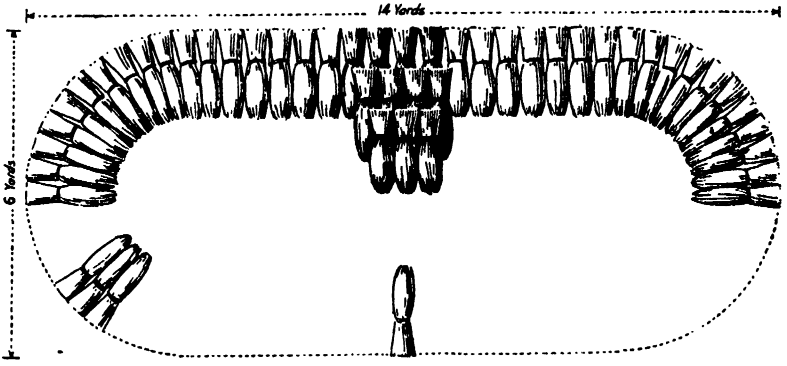


Fig. 1.—Diagram showing placing of the first layer. The second row binds the first to a little below the band; the third binds the second, and so on.

Commencing to Build.—When commencing to build the stack, place the first row of sheaves around the outside line with the butts out, then a second row inside these, but overlapping or "binding" them to a little below the band (see Figs. 1 and 2). Continue in a similar manner with further rows until the centre is filled.

The second layer is then placed on the first in a similar manner, and the building of the stack continued in this way until the height of the eave is reached. Care must be taken during this work that the centre of the stack does not become too high or too low; it should be from 1 to 2 feet higher than the outside. To prevent it becoming higher than this during building, draw the "binders" (binding sheaves) back a little; that is, bind more lightly. If on the other hand, the centre becomes hollow, the remedy is to bind a little fuller—or to put the binders further up. The outside rows of sheaves should have a slight dip outwards to ensure that water cannot run into the stack.

The walls should be kept perpendicular during building, as the weight of the hay settling will give the stack sufficient "spring"; that is, when the stack has settled, the walls will have sufficient outward slope. A "patter" is necessary to keep the walls straight and to pat in any sheaves which protrude too far. Such an implement can be made by fastening the end of a petrol case to a handle about 5 or 6 feet long.

Placing the Eaves.—When the walls have been raised to the height desired, the eave is built by placing the outside row of the next layer from 4 to 6 inches out beyond the line of the wall (see Fig. 2). It is essential that these eave sheaves have a slight dip out, and, if necessary, extra filling must be placed in the centre to ensure the required outward dip of these sheaves. On the correct placing of these eave sheaves depends the success or failure of the roofing of the stack. The eave sheaves support the roofing sheaves and they must have the correct dip (not too great) and be well bound.

Building the Roof.—The eave is bound by placing the next row, butts out, to the band of the eave sheaves; then that row is bound more lightly and the layer continued to the centre. The next layer is commenced by placing the outside row, butts out, about 2 to 4 inches in from the eave binders, and this layer is continued in to the centre in a similar manner to the previous layer. If the hay is of great length, a third layer above the eave and placed similarly to the other two would be necessary to give the roof sheaves sufficient pitch, but in most cases two layers suffice.

The roof is then commenced by placing the first roof row with the butts resting on the edge of the eave sheaves (see Fig. 2). In a properly constructed stack the first row of roof sheaves covers the eave and prevents any water coming in contact with it.

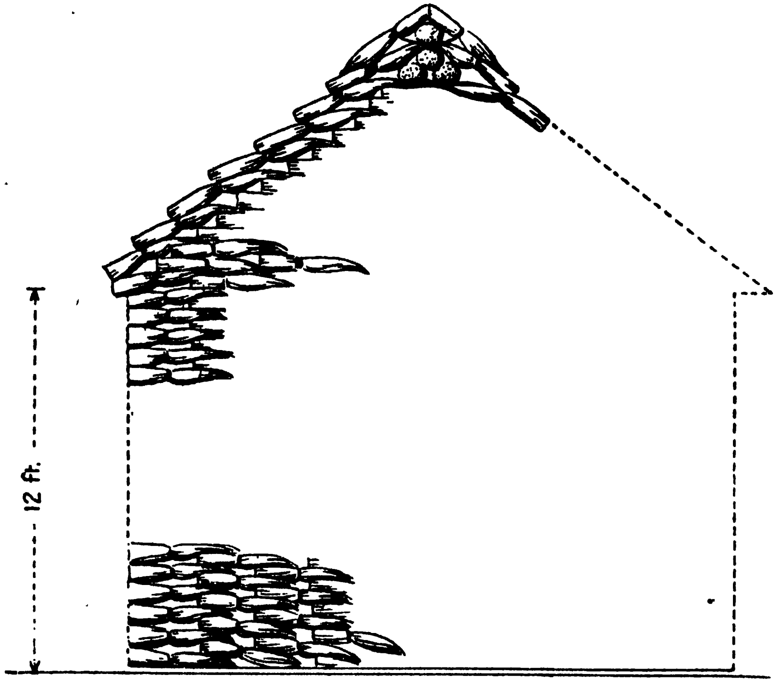


Fig. 2.—Diagrammatic representation of Cross Section Stack showing method of binding sheaves and building eaves and roof.

The first roof row is now bound by bending the heads inwards and just catching them under the butts of the outside row of the next layer of the stack (see Fig. 2), and this layer is now placed, the outside row being set just in from the row binding the roof row, and then a further roof row placed.

This building up of the stack and roof is continued until the roof sheaves meet across the top of the ridge along the centre of the stack. By this time the roof of the rounded end portion of the stack will be complete.

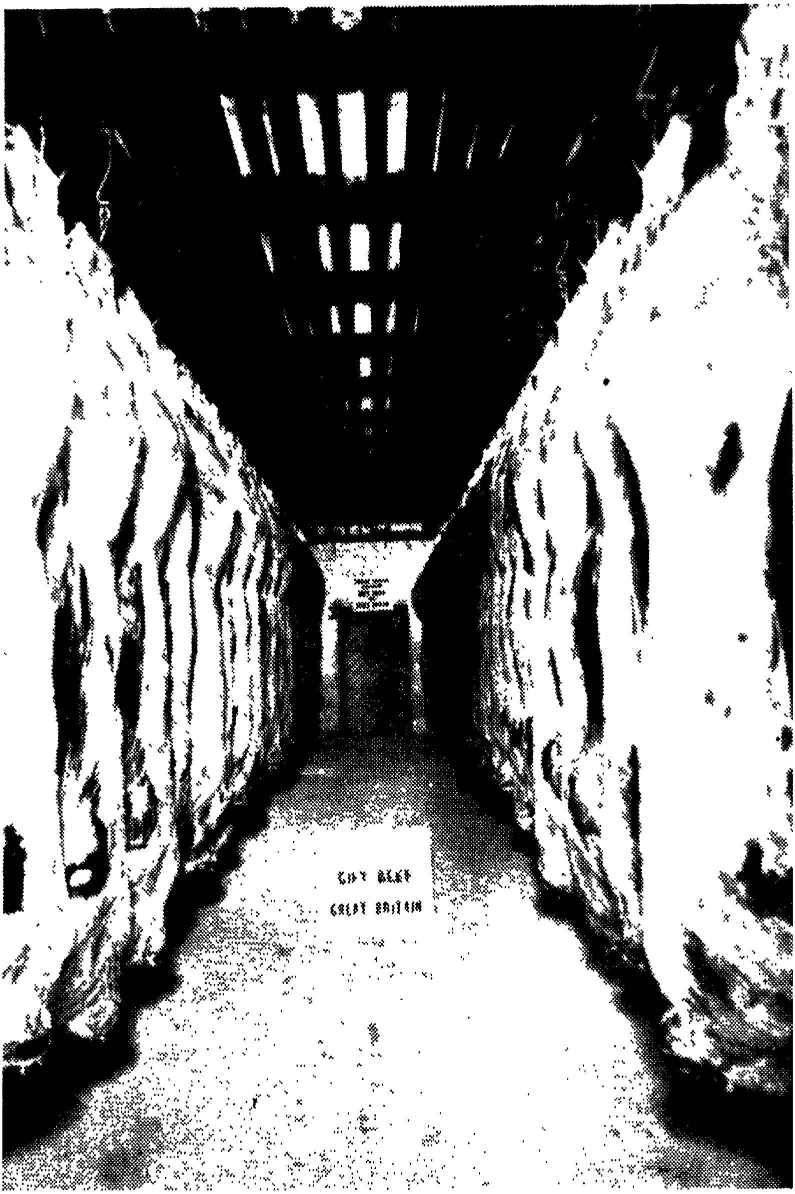
Care must be taken to see that the roof is not drawn in too quickly, as, irrespective of the pitch of the sheaves, the greater the amount of roof sheaf exposed, the greater will be the possibility of water soaking through the roof during a wet winter.

Capping the Stack.—A cap is commenced by placing side by side two rows of sheaves lengthways on the stack on top of the heads of the roofing sheaves, and then a third row of sheaves on top of these. It is desirable to keep the top line of the stack as level as possible, and, to achieve this these sheaves are best placed in pairs, head to head and slightly overlapping. There is then sufficient filling to enable the placing of the final row of roof sheaves in position with the heads overlapping a little.

The cap sheaves are now put into place, butts upwards and heads hanging down the stack; it is necessary to tie these sheaves into position, and this is done by tying twine from the band of a sheave on one side of the stack to the band of the corresponding sheaf on the opposite side. The work is commenced at one end of the ridge (one or two sheaves being placed to cover the actual end), and continued to the centre; then commenced again at the other end, so as to finish in the centre.

Organisation of Labour.—Some organisation of the labour required for stackbuilding is necessary if the work is to proceed without loss of time. In the recognised hay districts, a team of six men is usually employed as follows:—One stacker, one sheaf turner, three carters (with three wagons), one pitcher (who remains in the paddock). When the stack is built to a height (just before the eave is reached) sufficient to justify the use of the hay stage or plafform, a man is placed on the platform, and since the building from this stage onwards proceeds more slowly, one of the wagon men may be used for this work.

A Useful Hay Stage.—It is not difficult to construct a hay stage or platform. A useful size for the platform is 6 feet by 4 feet, and it should consist of 3 inch by 1 inch hardwood battens spaced 1 inch apart, bound across the ends with 3 inch by 1 inch hardwood battens, and carried on three 4 inch by 2 inch hardwood bearers; the platform is raised about 12 feet from the ground on 3 inch by 3 inch hardwood legs, which are braced with 3 inch by 1 inch hardwood battens. The legs have a spread at the base of approximately the dimensions of the platform.—*Agricultural Gazette of New South Wales.*


BEEF
GREAT BRITAIN

Gift Beef

The photograph on the opposite page is of a spontaneous and timely gift from the Rhodesia Stockowners' Association to the British Government. The chain of circumstances which culminated in the despatch from Cape Town on September 27th of fifty tons of Imperial and Grade A Rhodesian beef, began in June with letters in the *Rhodesia Herald* from Mr. D. M. Somerville and Mr. M. M. Goldberg. These letters suggested that the Rhodesia Stockowners' Association should organise a gift shipment of frozen beef and that all cattle breeders should play their part. The Stockowners' Association immediately circularised its members and approached the Government, the Cold Storage Commission and the Rhodesia Railways. The Railways at once agreed to transport the cattle and the resulting quarters free of charge; the Cold Storage Commission was equally eager to prepare the shipment without charge and the members of the cattle industry responded nobly. Cattle donated were disposed of to the best advantage and the resulting money was collected for the purpose of paying for the magnificent shipment illustrated.

This happy co-operation has resulted in a really valuable gift, which the High Commissioner will present to the Minister of Supplies, who, it is hoped, may be able to broadcast his thanks. Photographs of the consignment will be sent to the English Press.

Each quarter will bear a card stating that the meat is a gift from Southern Rhodesian cattlemen to the people of Great Britain and similar information will be stencilled on the hessian wrappers.

Letters to the Editor

SOYA BEANS.

The Editor, *Rhodesia Agricultural Journal.*

Dear Sir,—May I be allowed to congratulate the writer on the very excellent article on Soya Beans which appeared in the current Journal; from all appearances this crop is destined to take a big share in the farming practice in this country providing, as it does, such high quality feed for both humans and animals and at the same time acting as a soil renovator.

When discussing soil bacteria Mr. Arnold suggests spreading 400 lbs. of soil known to contain the correct bacteria per acre; my experience goes to show that if a coating of soil containing the necessary bacteria is given to each bean when planted and the soil in which the crop is planted has the necessary supply of humus the bacteria increases and the plants thrive, a crop of Otoxi planted in rows 36 inches apart was a thick mass shoulder high when reaped for hay.

In "Microbes by the Million" by Hugh Nicol (Pelican Series) a book every farmer should read, he says there are at least a couple of thousands of millions of bacteria in a salt-spoon of soil. This being the case the two important points to watch appears to be to see that the bacteria are not killed by being dried in the sun and that the soil in which the crop is planted is suitable to allow the bacteria to thrive.—Yours faithfully,

E. S. White.

Bretten, P.O. Concession, October 12th, 1940.

VELVET BEANS.

The Editor, *Rhodesia Agricultural Journal.*

Dear Sir,—In the October *Agricultural Journal* there is an interesting article by H. C. Arnold on new strains of velvet beans which are claimed to be superior to the Somerset variety.

Mr. Arnold says that the Somerset variety has one great drawback, *viz.*, numerous fleshy seed pods which require four weeks or more for drying before hay can be safely gathered together and stacked and that many farmers have had their hay rendered unpalatable or even quite unusable through gathering it before the pods were thoroughly dry.

I would like to suggest that the reason these farmers lost their hay was because they acted on the advice of the Agricultural Department regarding when to cut the beans for hay.

In all the articles that have appeared in the *Agricultural Journal* regarding making velvet bean hay the advice is the same, *viz.*, to cut when the pods are well formed but still green. I have made hay from Somerset velvet beans for many years and can say trom experience that it is impossible to make good hay if there are pods on the plants. The time to cut for hay is when the plants are in flower.—Yours faithfully,

J. F. M. McFadzean.

Caledonian Ranch, Banket, October 14th, 1940.

Mr. Arnold replies:—

The fact that the work described in the article entitled "New Strains of Velvet Beans" was commenced at least seven years ago shows that for a long period the Agriculturists have been aware of the difficulty experienced in curing velvet bean hay.

All investigational work conducted in Europe and America as well as Rhodesia, shows that bean crops in general contain the largest amount of nutrients at the stage of maturity, when the seeds are well formed but before the leaves fall. While the velvet bean crop is most suitable for silage when it reaches this stage of growth, when utilising it as hay, farmers have to choose between reaping it when it is only partially developed (Mr. McFadzean's method) or leaving it to become more fully developed at the risk of its being damaged during the curing process by unfavourable weather conditions. It is seen that both these methods entail either direct or indirect loss to the farmer.

The first method entails loss because a partial crop only is obtained. Records obtained at this Station show that the seed and seed pods in the mature growth of Somerset velvet beans weigh as much as the vines and leaves. Hence if the crop is cut at the flowering stage a smaller amount will be obtained than would have been available if it had been allowed to continue its growth for a few weeks longer. In this method the necessity for sustaining loss is accepted as inevitable.

The second method also entails loss because, although in favourable seasons the hay may be rolled and left in the field for as long as five or six weeks in order that the seed pods may become thoroughly dry before it is stacked, in other seasons showery weather intervenes, leaches out part of the nutrients and necessitates frequent turnings to prevent the formation of mouldy patches. By the use of tripod racks which keep the material off the ground the hay may be cured satisfactorily, but here again the extra labour required for collecting the poles, erecting the tripods, etc., adds somewhat to the cost of curing the crop.

It is seen, therefore, that the source of the trouble lies in the large size and fleshy texture of the seed pods. It is not claimed that all the difficulty will completely vanish if the Marbilee and Jubilack strains are grown in place of the Somerset variety, but it is confidently expected that the new kinds will be found more profitable because they produce a larger proportion of vines and leaves and, owing to the pods being formed later in the season, the curing of the material can be postponed until fine weather is almost a certainty. It will probably be found that the best time to cut for hay will be at the stage when the largest pods are not more than three-quarters of an inch in diameter. When cut at this stage the risk of loss through long exposure will be reduced and a high protein content in the material will be ensured.

Carrying the "hands" of fibre from the drying shed to the baling press.

Putting bundles of stalks in the river.

Sunnhemp Fibre

In order to form some idea of the amount of labour required to separate the fibre by hand from the stalks, on a moderate scale, the following work was carried out:—

One wagon load of stalks was treated per day. The wagon had a framework of gum poles which enabled two stacks of stalks to be carried, the heads facing each other. By using a more suitable framework much larger loads could be carried. The wagon was loaded in the morning and the stalks dumped by the river side. In the afternoon the two natives who did the loading tied the stalks into bundles, put them in the water and weighted them down with a stone on each bundle. The best results were obtained after the stalks had been in the water from six to seven days.

To start with the stripping was slow, but it was soon found that a handful of stalks could be broken and stripped together instead of singly. The fibre was collected into hands each hand holding that from perhaps 100 stalks. It was then beaten on a plank by a stick at the water's edge and rinsed repeatedly while being so beaten. From there the hands were taken to a tobacco tying shed and hung over poles till dry, then to a baling press, the average bale weighing 120 lbs.

A wagon load as described produced approximately one bale of fibre. The labour cost came out at approximately one penny per pound of fibre. The chief item is stripping, which was done by youngsters. Could machinery be substituted for this operation it should be possible to halve the cost. The stalks had already produced a crop of from 2 to 3 bags of seed per acre. All refuse from the fibre was put into cattle kraals for manufacture into compost.

Some 8,000 acres of sunnhemp were harvested this year. Allowing a return of 500 lbs. of fibre per acre, which I am assured is very low, this means that a potential four million pounds of fibre will either be burned or turned into manure.

The method described is as crude as is possible; the fibre before use would have to be put through a scutching machine. I have, however, proved to my own satisfaction that sunnhemp fibre can be produced by the bale at a not unreasonable cost by hand. Given a suitable machine and we have an alternative crop for the maize districts.—Your faithfully,

Chipoli, Shamva, October 16th, 1940. J. M. MOUBRAY.

Turkish Tobacco

CULTURE AND MARKETING IN SOUTHERN RHODESIA.

By J. C. Collins, B.Sc., Assistant Tobacco Officer.

Requests have been received from growers for more up-to-date information regarding the production and disposal of Turkish tobacco, for since the publication in December, 1928, of Departmental Bulletin No. 715, "Turkish Tobacco Culture in Southern Rhodesia," by D. D. Brown, Chief Tobacco Officer, certain important changes have been introduced, changes which are associated mainly with the processes of curing and the methods of marketing. It should be realised, therefore, that this article essentially constitutes a revision of that Bulletin and in consequence appreciation is accorded to Brown for use of the foundation material.

The changes referred to are largely the result of a distinct variation in the type of tobacco now demanded by the manufacturers, the nature of whose demands is in turn controlled to a large extent by the tastes of the smoking public.

Climate.—Seeing that Turkish tobacco is sun-cured, it necessarily follows that climate plays an all-important role. The incidence of rain during curing operations may cause considerable damage to the leaf on the curing racks, for once the leaf becomes wet, it is liable to discolour badly. Similar damage will result from excessively humid atmospheric conditions such as heavy mists. Rain, however, is essential during transplanting operations and the period of early growth, but once the plants approach maturity, there should be no heavy downpours but just light showers, sufficient to help on the plants but insufficient to wash the gum off the ripening leaf thus rendering the cured produce thin, papery and lacking in body, flavour and aroma.

The production of Turkish tobacco should, therefore, be limited to localities where the rainfall normally ceases one month after transplanting and thereafter there are only scattered showers, with practically no rain or mist during the curing season. The plant is also very susceptible to frost and should not be grown in areas where early frosts are of common occurrence.

In Southern Rhodesia, where the rainy season normally commences between the end of October and mid November and continues till the latter end of March, the period of heaviest rainfall being December to February, transplanting operations usually commence about the beginning of January and terminate in March.

As a result of the crop being planted later in the season than is Virginia tobacco, it follows that planting conditions are far more satisfactory, as not only can one count on receiving a shower of rain, but the soil, too, has by this time built up a fairly high moisture content, thus enabling the young transplants to establish themselves more readily.

The question of when to prepare and sow seed-beds is dealt with at a later stage in this article.

Soils.—In the old days the demand was for leaf dark mahogany in colour so that the crop was grown to advantage on red clay loams derived from diorite, dolerite, schist and banded ironstone formations. To-day, however, the exact reverse is the case. There is no longer a demand for dark leaf; what the market now wants is bright leaf varying in colour from lemon to light mahogany. In consequence production should be confined to sandy loams of granitic or sandstone origin and to the lighter types of "contact" soils.

"Contact" soils are essentially intermediate in texture and structure between light and heavy-bodied soils. They occur on the line of contact at which the one type merges into the other and, consequently, the regions nearer to sand veld are lighter in body than those contiguous to clay soil. It is the lightest of this class that is used for Turkish.

Both the sandy loams of granite and sandstone origin, as well as the light "contacts" show considerable variation in colour. They may be white, pink, light red or various shades of grey.

Confusion should not be made between light soils and infertile soils. Because a soil happens to be light in texture it does not necessarily follow that it is infertile. Nor, because a heavy clay soil has been found to be lacking in fertility should the grower consider planting it to Turkish tobacco. For the production of good quality Turkish it is absolutely necessary to select a good fertile light soil.

Soil fertility depends upon a number of factors, and of these the following five are considered to be the most essential. All five are of equal importance.

(1) Abundance of available plant food (richness), *i.e.*, on virgin veld a thick vegetative cover not only of bushes and trees, but also of grasses and weeds. On non-virgin veld the adoption of the principles of good field husbandry.

(2) A good mechanical state, *i.e.*, a texture which will allow of successful tillage.

(3) Absence of injurious substances.

(4) A wholesome or permeable subsoil.

(5) A suitable situation.

A soil possessed of all these conditions will be well-drained, mellow and wholesome, whereas, if deprived of any one of them, its agricultural value will be destroyed.

Soil texture greatly influences the yield and quality of the tobacco produced; the standard of both being reduced where the soil particles are large and coarse. Improvement can, of course, be effected by proper applications of fertiliser, but whenever possible it is generally more economical and more satisfactory to use a finer textured soil.

Depth of soil is another important factor. In Southern Rhodesia the depth of top-soil varies from about three inches to eight inches on granite sandveld and to a greater depth in soils of sandstone origin. It is generally recognised that other things being equal a deep soil is likely to be more productive than a shallow soil, even if the former is deficient in its percentages of fertilising ingredients.

When selecting soil for the crop, the nature of the sub-soil must also be taken into account, as it has a marked bearing on the quality of the top-soil. If the sub-soil is a stiff. impervious clay the land may become water-logged during seasons of heavy rainfall and as a result of this condition the sub-soil is sure to contain sour materials due to imperfect oxidation, which may even be actually poisonous to the tobacco. On the other hand, too porous a sub-soil such as an open gravel, will not retain sufficient moisture, and will result in excessive leaching of plant food material, so that the crop is liable to suffer from drought and starvation.

Brown has described the most suitable sub-soil underlying granite sandy soils as being reddish in colour and containing clay, sand and gravel in suitable proportions. He also warns growers against a bluish coloured clay sub-soil which is to be found in certain parts of the Colony.(1).

Closely coupled with soil conditions is the question of the locality itself. As much as possible avoid large exposed, wind-swept areas. The land selected should be sheltered from the prevailing winds and should have a gentle slope with a good natural drainage.

Selection of Seed-bed Site.—In selecting the site for the seed-beds the following points should be taken into consideration:—

(1) Proximity to a permanent water supply.
(2) Suitability of soil.
(3) Proximity to the fields.
(4) Proximity to the homestead.
(5) Exposure.
(6) The nature of the terrain.

It is essential that the site be as near to a permanent water supply as is possible. Owing to Turkish seed-beds being sown in December, that is during the early stages of the rainy season, they do not require as much artificial watering as do Virginia beds, nevertheless, as considerable recourse has to be made to the watering can, the water supply should not only be permanent but near to hand.

The site selected should possess a good natural drainage, and for this reason vleis should be avoided as they are apt to become water-logged during heavy rains.

The most suitable soils for tobacco seed-beds are sandy loams and alluvial soils which have a good supply of humus and are naturally well drained, friable and fertile.([2])

The proximity of the seed-bed site to the fields in which the tobacco is to be ultimately planted is another important factor, though not a vital one. Close proximity naturally eases the situation as far as time and labour is concerned, and it also enables the young seedlings to reach the field before they have had time to wilt.

Seed-beds are the foundation of the crop; they can never receive too much attention. The nearer the site is to the homestead the greater will be the supervision the beds receive. The grower should visit the site at least twice daily to note the progress the seedlings are making and to see that they are being properly thinned out and that spraying operations with some fungicide such as Bordeaux mixture or Bouisol is being carried out at regular intervals and in an efficient manner.

At the time of transplanting experienced supervision is necessary to see that only healthy seedlings and plants of the correct size are being pulled.

The question of exposure is an important one. The beds should be so located that they receive a maximum amount of sunlight, particularly in the early mornings—eastern and north-eastern exposures are the best.

The site should be sheltered from the prevailing winds. Where no natural protection is afforded an artificial shelter consisting of long grass or reeds should be erected around the site leaving space for a gate on the side nearest to the water supply.

When selecting the site due consideration should be paid to the general nature of the terrain. Try and select a fairly level piece of ground or one with only a very gentle slope. As far as possible avoid steep slopes, but where this is impracticable the beds should be arranged in terraces and the necessary precautions should be taken to protect them from damage by surface wash from higher levels.

Wherever there is the slightest risk of the seed-beds being damaged by a rush of water during a storm, large ditches should be dug round the four sides of the site and an outlet for the water be provided at the lowest point. Where artificial shelters are to be provided, space should be left for them between the drains and the actual seed-bed area.

Small drains are ineffective. The ditches should be large enough to properly protect the area. Their depth will depend upon the slope of the land, but they should be not less than three feet wide.

It might be impossible on some farms to find a site which incorporates these six major requirements, but such a difficulty can generally be overcome by realising that the texture of the soil for seed-beds can be greatly improved by judicial treatment. For instance, if the soil is too heavy and stiff apply a few wagon loads of sand to the surface and mix it in to a depth of 6 or 8 inches. On the other hand, where the soil is too light and friable a similar treatment with a heavier type of soil will do much to improve the texture.

On no account in the following season should a site be used in which the seedlings of the previous season have shown signs of disease because, by so doing, the new plants are rendered more liable to attack by insects and bacterial and fungoid diseases which may have been carried over in the soil as a result of imperfect soil sterilisation.

The question of annual soil sterilisation by burning is in itself another reason for not making continuous use of the same site year after year. Unless strict and careful attention is paid to the amount of residual wood ash allowed to remain on the site there is the danger of an excess amount being incorporated in the soil, thus rendering it alkaline—a condition which is accentuated in this country by the high degree of the alkalinity of the water, particularly in certain areas, during seasons of late rainfall.(4).

Preparation of Seed-beds.(5)—The sites should first be cleared of all vegetation and then be levelled. The area cleared should be in excess of the actual area required for the seed-beds so that a clear space surrounds the beds and so reduces the chances of incursion by insect pests and of the seeds of weeds being blown among the germinating tobacco seed. This work should be carried out during the winter months and some time previous to the final preparation of the beds so that sufficient time is allowed for the destruction of the natural vegetation by decomposition and dessication. The soil should also be worked at frequent intervals with this same object in view.

A few days before the date of seeding the site is lined off into beds with pathways between. The beds may be made any length desired but should not be wider than five feet, as a width greater than this renders it difficult for the labourer to attend to plants along the centre of the bed.

The pathways between the beds should be sufficiently wide to allow a workman ample space to move about freely and in comfort. Two feet six inches may be regarded as being convenient for this purpose.

If it is the intention of the grower to have his beds raised above the level of the pathways, the next operation will be to throw up soil from the pathway on to the adjoining area marked off for a seed-bed. If on the other hand the intention is to have the beds level with the path and to be bordered by bricks, then naturally this operation is omitted.

The soil for each seed-bed should next be worked to a fine tilth prior to being sterilised. In Southern Rhodesia the open fire method of sterilisation is the one adopted. The process consists of covering the entire site—seed-beds and pathways—with a layer of grass (to encourage conflagration) underlying a requisite amount of fuel. A layer of brushwood to a depth of about two feet or maize cobs to a depth of six inches is very satisfactory for this purpose. Tobacco stalks should not be used, as there is always the danger that they may be carrying diseased tissue, scraps of which may fall in the immediate area surrounding the sterilised site and so be a source of infection, particularly of wild fire, angular spot and eelworm.

The best results are derived from sterilisation when the soil is in a moist condition and when burning is carried out on a calm day so that maximum benefit can be derived from the heat generated by the burning material. The soil should not be sterilised when it is saturated with water, nor, to obtain satisfactory results, should it be too dry.

A simple test described by Brown(³) to determine whether or no the soil has been properly sterilised, is to bury a potato about three inches below the surface of the soil in the seed-bed before burning. When the potato has been sufficiently cooked to allow the skin to be pealed off easily, the sterilisation may be considered to have been carried out sufficiently.

The secret of good sterilisation lies in arranging the fuel uniformly, to the depths previously suggested, over the entire surface of the soil and to carry out the burning on a calm day when there is no strong wind blowing and with the soil in a moist out not saturated condition.

After burning, the area is allowed to cool down and all the unburnt portions of the material used for sterilising the beds should be removed and the charcoal and ash should be scraped off so that there is not more than a uniform depth of half to one inch of ash remaining. Taylor(⁴) has described the danger which may result from incorporating an excess of ash with the soil, particularly in the case of seed-beds which are used year after year.

The next step is to border off each bed on all four sides with a single row of bricks placed on edge lengthwise. This practice is not essential where the beds are raised above the level of the paths, as in such case they are not liable to get damaged so easily by labourers walking about on the pathways between the beds and, also, they tend to absorb water more freely, but when the beds are made on level ground the brick border becomes a necessity, as not only does it assist in protecting the germinating seedlings from damage by insects and humans, but it also serves a most useful function in reducing the volume of water which would otherwise escape from the beds to the paths.

Once the grower is satisfied that the soil has been worked into a fairly fine tilth the beds may be regarded as ready for a dressing of fertiliser. The tilth on the actual surface of the bed should not be too fine and powdery, as in such condition the seed tends to get washed badly, resulting in a very ununiform germination. On the other hand, if the soil particles are too large the condition is again undesirable. The best results in germination are obtained when the surface has a moderately rough appearance with no soil particles larger than a quarter of an inch in diameter, *i.e.*, slightly smaller than an ordinary garden pea, but not pulverised into powder.

There are on the market a number of fertilisers specially prepared for use in tobacco seed-beds, but should the grower desire to mix his own fertiliser Brown(²) recommends the following formula:—

½ lb. nitrate of soda

½ lb. sulphate of potash

1 lb. superphosphate

mix thoroughly.

The above quantities when mixed together are sufficient for 10 square yards of seed-bed. The fertiliser should be broadcast evenly over the surface of the bed and should then be thoroughly incorporated with the top three inches of soil —care being taken not to bring unsterilised soil to the surface, as this would vitiate the good done by sterilising. After raking over thoroughly to ensure that the surface is level and the tilth satisfactory the bed may be regarded as ready for sowing.

An allowance of 100 square yards of seed-bed should be made for each acre of tobacco it is intended to plant in the field.

Turkish seed-beds are normally sown from the beginning of December to the middle of January.

It has become the practice on some farms on which both Virginia and Turkish are grown to make use of the Virginia beds for the sowing of Turkish, but this practice can only be considered permissable when the grower has made absolutely certain that there was no sign of disease such as wildfire, mosaic, frog-eye, angular spot or nematode in the Virginia seedlings. This site should be re-sterilised before being sown to Turkish.

Tobacco seed should always be cleaned of all chaff and dirt adhering to it and should then be treated with a suitable chemical, such as a solution of silver nitrate, to destroy bacteria which may cause an outbreak of wildfire and angular spot.

Tobacco growers may avail themselves at small cost of the services offered by the Chemistry Division of the Department of Agriculture in connection with the cleaning and treating of seed.

It is unwise to sow seed too thickly, as the resulting growth is far too dense and the seedlings become long and lanky instead of being sturdy little plants. Also, too dense a growth calls for additional thinning out, and this in turn not only loosens the soil around the remaining plants but it may also lead to certain diseases being transmitted to the beds by the medium of the " boys' " hands. For instance, it is known that the mosaic virus can be carried over in snuff made from mosaic infected leaf, so that a person who has been handling such material is a source of danger to the tobacco seedlings. Within reason, the less the plants are handled the better.

Generally speaking, one heaped teaspoonful of cleaned and treated seed of good germinating capacity is sufficient to sow 25 square yards of seed-bed. This amount is, of course, a variable one. Experienced growers may get good results by using slightly less, whereas others may require to use more.

Tobacco seed is so small that unless it is "carried" in some other medium such as finely sieved ash, mealie meal, sand or water, it is impossible to broadcast such a small quantity over a large area.

Mealie meal, ash and a light coloured sand are all ideal for this purpose, as when broadcast they show up well on the surface of the bed and so serve as indicators of the uniformity of the sowing. They should be in a thoroughly dry condition and, in the case of ash and sand, should first be passed through a sieve of fine mesh. When sand is being used, care should be taken to see that it has been obtained from a depth of more than two feet below the surface of the ground, otherwise there is a danger of the seeds and roots of weeds, particularly of grasses, being transmitted to the beds where, under the ideal conditions pertaining, they may take root and so prove a menace.

In using one of these solid distributing mediums the procedure is to place a sufficient quantity of the ash, mealie meal or sand for one seed-bed in an enamel dish or other suitable container and over the levelled surface to carefully and uniformly sprinkle half the requisite amount of seed, thoroughly mixing it into the medium. Repeat the procedure using the remainder of the seed. Broadcast carefully over the bed.

When using water as the carrying medium, the seed is merely added to the water in the can, thoroughly stirred with a stick and sprayed on to the bed. This method does not give as good results as are obtained by using ash, sand or mealie meal, as the tiny seeds tend to adhere to the sides and top of the can and, unless properly stirred—even during the actual process of watering on to the bed—the distribution is not as uniform as might be desired and cannot be detected at the time as readily as in the case of the light coloured solid.

Immediately after the seed has been sown the bed should be thoroughly watered, using a watering can fitted with a fine rose. Next cover with cheese cloth or grass.

Where the latter is being used, a fairly thin layer of reeds are tied to a framework of horizontal sticks which are supported on Y-shaped wooden props about a foot high and driven vertically into the ground at appropriate intervals along the edges of the bed. As the seedlings become established and require more and more sunlight the grass is gradually thinned out and in the final stages the frames can be removed during the day and brought into use again at night or during heavy rain.

Cheese cloth, however, allows of more rapid germination and development and looks far neater than does grass. Its use is therefore advocated whenever conditions permit.

A wire is stretched along the centre of the bed from one end to the other and is supported about 14 inches above ground level by means of wooden pegs driven into the ground at suitable intervals of, say, ten feet. To this wire the cloth is attached by being tied along its centre seam with loops of twine. The edges of the cloth are left free so that when not in use the two sides can be rolled up and laid along the wire. When required to shelter the seedlings, however, the sides are rolled down and held in position along the edges of the bed by bricks being placed on the edge of the cloth at intervals of about eighteen inches or less.

In addition to the other advantages already enumerated cheese cloth does not harbour insects as readily as does grass, it can be handled more easily, it permits a better distribution of sunlight and, if given reasonable care, it can be used for a number of seasons. Before being used again, however, it should always be sterilised against fungoid and bacterial organisms by boiling thoroughly in water.

Seed-beds must receive unremitting care and attention. The soil should never be allowed to dry out but should always be kept in a nice, moist and friable condition.

At first the beds should be kept covered the whole time, except of course for the short periods when they must be uncovered for watering. Later when the seedlings have grown a little, they may be exposed to the early morning and late afternoon sun. The period of exposure is gradually increased each day so that by the time the plants are the correct size for transplanting (4-6 inches in height), the covers are left off all day and used only at night or when a storm is threatening.

The amount of water applied to the beds should be gradually reduced so that by the time the plants are 4-6 inches high they are only receiving sufficient to keep them from wilting.

A combination of these two effects, *viz.*, increased exposure and reduced moisture content, will help to harden the plants and thus enable them to stand up better to transplanting conditions.

The beds should be kept free of weeds and grasses and the plants should be thinned out sufficiently to allow the remaining ones to receive ample air and light. The advice on hygiene and control of diseases described by J. C. F.

Hopkins, Plant Pathologist, in Bulletin No. 653, and in his book "Diseases of Tobacco in Southern Rhodesia," should be strictly observed.

Should the plants fail to make satisfactory progress, an immediate attempt must be made to try and ascertain the cause. It will probably be due to disease, insect pests or unsatisfactory soil conditions. Generally a sickly yellow appearance indicates a lack of plant food, particularly of nitrogen.

Nitrogen deficiency may be made up by a suitable application of nitrate of soda. Dissolve 1 lb. of nitrate of soda in 8 gallons of water and apply to about 20 square yards of seed-bed surface(2). A more complete food, however, is provided by liquid fowl manure. Brown(2) describes the preparation and use of it as follows: "Take a suitable receptacle and half fill it with fowl manure. To this add sufficient water to fill the receptacle. The receptacle should be allowed to stand for about 5 or 6 days and its contents frequently stirred at regular intervals. After standing for this period, the liquid manure is ready for use. One gallon of liquid fowl manure is diluted in eight gallons of water; this should be applied to ten square yards. A second application of liquid fowl manure may be given a few days after the first application. . . ."

"Immediately after the application of nitrate of soda and liquid fowl manure, the beds should be watered to wash the solutions from the plants and so prevent the leaves of the seedlings being burned. When possible, application should be made on a dull, cloudy day, so as to reduce the danger of the leaves being scorched."

"None of the above should be applied to young seedlings with leaves smaller than a threepenny coin, as the young seedlings would be damaged by the solution."

Rotation of Crops.—In this Colony Turkish tobacco seldom features on the farm as the principal item of field husbandry. In the vast majority of cases it is grown in conjunction with Virginia flue-cured tobacco because a combination of the two constitutes an ideal economic unit on the farm by providing work throughout the year, not only for the large staff of natives employed but also for the more highly paid European supervisors.

In addition, the one generally offsets any financial loss that might be sustained through the other, for it is seldom that adverse climatic conditions will effect both crops, seeing that the times of planting are widely spaced—Virginia being planted from November to December and perhaps January, and Turkish from January to March.

The best quality leaf is always obtained from a crop grown on virgin soil. It is not advisable to grow more than two crops of tobacco in successive seasons on the same soil, as the leaf of subsequent crops tends to be harsh in texture. This calls for the adoption on the farm of some suitable system of crop rotation.

The theory of rotation is based upon the different proportions of nutrient materials absorbed by plants, on the presence of matter from the decay of plants and on the excretions from growing plants which may poison the soil for plants bontanically related to them and following immediately after.

It is the root range of a plant which largely determines the food requirements of the plant. Some crops, like tobacco for instance, are deep-rooted and will procure their food requirements from a greater depth, and consequently a greater area of soil than will a more shallow-rooted crop such as maize. In a rotation, therefore, better balance is maintained amongst the nutrient substances in the soil because there is a range of crops demanding different proportions of plant food.

There is also considerable variation in the effects produced in the soil by different crops. For instance, legumes add nitrogen to it, whereas cereals tend to use it up; fibrous and fine-rooted crops such as grasses and cereals exert a beneficial effect on the mechanical condition of the soil, whereas root crops and potatoes use up humus and so tend to leave the soil in a relatively poor physical condition.

Another advantage of rotations is that they minimise the risk from plant diseases and insect pests, and in doing so serve as a useful measure of control. The root-knot nematode (*Heterodera marioni*) will flourish on tobacco but it will not touch grasses; therefore in a nematode-infested soil, the production for a number of years of crops resistant to nematode attack will tend to starve out the pest.

The choice of a rotation for any particular farm will depend upon a great number of factors, the principal ones being the suitability of soil and climate to the different crops the farmer has in mind, the economic value of the different crops, the distance of the farm from marketing centres and the susceptibility of the different crops to fungoid and bacterial diseases and to insect attack.

In this Colony there is still much room for experimentation in connection with rotation of crops on tobacco soils, but the following suggestions may prove helpful:—

1 *Five-course Rotation.*

1st year (virgin soil)	Tobacco, either Virginia or Turkish.
2nd ,,	Tobacco, either Virginia or Turkish.
3rd ,,	Maize (or similar crop).
4th ,,	Legume ploughed under.
5th ,,	Maize (or similar crop).
Repeat.	

2. *Six-course Rotation.*

1st year (virgin soil)	Tobacco, either Virginia or Turkish.
2nd ,,	Tobacco, either Virginia or Turkish.
3rd ,,	Groundnuts.
4th ,,	Legume ploughed under.
5th ,,	Maize.
6th ,,	Grass.
Repeat.	

3. *Six-course Rotation.*

1st year (virgin soil)	Tobacco, either Virginia or Turkish.
2nd ,,	Tobacco, either Virginia or Turkish.
3rd ,,	Legume ploughed under.
4th ,,	Maize.
5th ,,	Grass; or allowed to revert to natural vegetation.
6th ,,	Grass; or allowed to revert to natural vegetation.
Repeat.	

4. *Six-course Rotation.*

1st year (virgin soil)	Tobacco, either Virginia or Turkish.
2nd ,,	Tobacco, either Virginia or Turkish.
3rd ,,	Maize.
4th ,,	Legume ploughed under.
5th ,,	Grass; or allowed to revert to natural vegetation.
6th ,,	Grass; or allowed to revert to natural vegetation.

Repeat.

In each of the above examples the rotation has commenced with virgin soil being planted to tobacco. This, however, is not a necessary procedure and should not deter persons who have no virgin soil available from growing tobacco. As previously mentioned, however, the best quality Turkish leaf is always obtained from a crop grown on virgin soil, and for this reason, whenever farming conditions will allow, virgin soil should be reserved for the Turkish crop.

There is a large choice of legumes open to the farmer for green manuring purposes, but owing to the serious incidence of root-knot nematode(7), it is advisable that his selection be restricted to legumes resistant to eelworm attack.

The following is a short list of plants of economic importance known to be resistant to eelworm infestation:—

Velvet Beans.—Florida, Mauritius, Somerset

Cowpeas.—Monetta (almost invariably), Brabham, and varieties of Victor and Iron.

Sunnhemp.

Maize.

Munga.

Oats.

Soya Bean.—Laredo variety.

Wintersome.

Peanuts.—Most varieties, including Valencia, Virginia Bunch, Masimbika, Jumbo.

Grasses.—All species.

It has been found(7) that by growing tobacco on land known to be infested with *H. marioni* the infestation can be increased by ninety per cent. in a single favourable year. Infested lands should therefore not be planted to susceptible crops.

Preparation of the Land.—As this aspect of the subject has been fully dealt with by Brown in his Bulletin(8), there is no need for further elaboration, but for convenience of reference his views are quoted verbatim hereunder.

"It is essential that after being transplanted, the tobacco should make rapid and continuous growth. The field should, therefore, be properly prepared and the soil should be brought into as perfect a tilth as possible.

"In preparing virgin soil, it is desirable that the land be stumped, cleared and ploughed during the preceding rainy season. Stumping is best done during the months of the heaviest rainfall, when the soil is thoroughly soft. A point to be remembered when stumping and clearing new land is that the timber should be drawn off the field, not piled there and burnt. If burnt on the field, the heavy ash residues left on the land will give rise to an uneven crop of tobacco. The newly-cleared field should be ploughed—usually about March and April—while the grass and vegetation are still green and full of moisture, and before the soil becomes too dry or hard.

"When handled in this manner it will be found that the land can be more thoroughly ploughed; all vegetation turned under is more readily decomposed and converted into humus, and the soil is rendered more friable and retentive of moisture. After lying fallow during the winter months, the land should be ploughed and cross-ploughed, and then harrowed with a heavy disc-harrow, being finally brought into a good tilth by means of drag harrows.

"Generally speaking, the tobacco soils of Southern Rhodesia are inclined to be rather shallow, and great care should therefore be taken in the ploughing operations, so that only the top-soil is turned over by the plough. A quantity of the sub-soil brought to the surface through ploughing too deeply will have a detrimental effect on the crop.

"Land which has already been under crop should, if possible, be ploughed as soon as the crop is harvested, so that a certain amount of soil moisture may be conserved and also to assist in the destruction of insect pests which may be hibernating in the soil. Such soils should be ploughed again during the early part of the following season, and brought into good tilth just prior to planting.

"With all soils, whether virgin or previously cropped, it is imperative to secure a good tilth before planting. Whenever possible, the final ploughing and harrowing should be made when the soil has been moistened by showers of rain which fall at the commencement of the wet season, since any weeds coming up at this time will thus be destroyed, and subsequent weeding will be reduced to a minimum.

"Suitable drains should be made where necessary to lead off storm water. Around each field a strip of ground (say 20 feet wide), kept free from weeds and grass, will assist in checking insect pests. When the outer edges of the fields are straight, and suitable pathways are left at convenient intervals across the field, a good deal of time and damage will be saved during the working of the crop."

Manurial Treatment.—Owing to the variation which exists not only in the type of soil used, but more so in the degree of fertility of those different soils, it is not possible in a work of this description to deal separately with the fertiliser requirements of each type. The intention here is to treat that subject in a very general manner.

First and foremost, as has been previously pointed out under the heading of "Soils," it is necessary to select a well-drained, deep, fertile, light bodied soil. One lacking in humus will tend to produce leaf harsh in texture and lacking in oil.

The average soil in this Colony suited to the production of Turkish type tobacco has a requirement of some 175 lbs. per acre of a fertiliser of composition 3% nitrogen, 9% phosphoric oxide and 9% potash. The fertiliser is applied broadcast and is harrowed into the soil before planting operations commence.

Experiments with the use of compost are in course of trial and it is hoped that this material will prove useful in building up and maintaining the humus content of our tobacco soils.

Transplanting Operations.—It has been found from experience that the best results are obtained from fields which are planted between mid-January and mid-February. The optimum size of seedling for transplanting purposes is one of about six inches in height. The seedlings should not be less than four inches tall, as very small plants seldom make good progress owing to their extreme tenderness. A few hours of strong sunshine before they have had time to establish themselves will cause them to wither and die. Also, a very heavy downpour of rain will tend to batter them down so that they become buried in the soil. On the other hand large, tough, woody, overgrown plants seldom grow out well when planted in the lands and so the grower should avoid the temptation of making use of these overgrown seedlings, no matter how healthy they may look in the seed-beds.

Method of Transplanting.—Transplanting is best done on days when the sky is overcast and there are frequent showers of rain. Such ideal conditions are not always obtaining, however, so that the time of transplanting will depend, in the main, on the moisture content of the soil. It is unwise to transplant tobacco seedlings unless the soil is sufficiently moist to prevent them from wilting. Generally speaking, do not transplant unless at least the top three inches of soil are in a moist condition. Provided the soil is sufficiently moist, tobacco may be transplanted throughout the day, but the best time is during the cool hours of the afternoon.

It should always be remembered that the little transplants are very tender and must not be subjected to any hardships which can be avoided. For instance, if at the time of removal of the seedlings, the soil of the bed appears to be dry, it should be well watered so that it becomes nice and soft before the plants are actually pulled. This will reduce to a minimum the chances of injury occurring to the roots and young leaves.

When carting the young transplants from the seed-beds to the field, they should not be exposed to the full rays of the sun but should be covered with hessian or other suitable material.

In this Colony the spacing normally employed for Turkish type tobacco is 18 inches by 9 inches. That is the rows of plants are 18 inches apart while the plants in the row are spaced 9 inches apart. Such spacing demands approximately 39,200 plants per acre, that is eight times as many plants as are required for Virginia flue-cured tobacco when spaced 3 feet by 3 feet.

It is apparent, therefore, that to use the same method to mark out a land for Turkish type as one does for Virginia—that is, to indicate the proposed position of each plant by inserting the stem of a grass at that point—would be a very laborious task indeed, particularly where it is intended to plant large acreages. This operation has been much simplified by the use of the "dundoo," or marking frame.

The "dundoo" as the natives call it, is a home-made implement of very simple construction and design. It merely consists of a frame comprising four or five upright straight sticks five feet high and 1½ inches in diameter, separated from each other by distances of exactly nine inches and held together firmly in position by three horizontal bars. The lowest of these bars is fastened to the uprights at a height of 12 inches above ground level and the topmost one about 3 inches below the tops of the uprights. The remaining one is fastened in between these two. Their function is merely to keep the uprights firm and spaced at intervals of 9 inches. To ensure greater rigidity the frame may be supported by two more supports fastened crosswise. The lower ends of the four or five uprights should be pointed and preferably be fitted with steel ferrules.

The implement is used in conjunction with a wire marked off at intervals of 18 inches, *i.e.*, the distance required between the rows of plants. The wire is first placed along the top edge of the field and drawn taut; two natives then walk along the length of the wire holding the dundoo between them at right angles to the wire. When level with each mark on the wire, they bang the dundoo down into the soft moist soil, thus not only marking off the position, but also making a suitable hole for the intended transplant. When they have reached the last mark, the wire is lifted and pulled taut along the last line of holes made by the dundoo and the process is repeated until the entire field has been marked off.

This combined operation of marking and dibbling is immediately followed by the actual transplanting. The tap root should go straight down into the soil, as a bent tap-root is liable to interfere with the satisfactory growth of the plant. Excessively long tap-roots should be nipped off to a convenient length.

Do not allow the "heart" of the plant to get buried under the soil and do make sure that the soil around the plant is pressed down well. Native labourers are apt to overlook the importance of this operation, and as a result the transplant does not take hold satisfactorily. It is impossible to keep a strict check on the work of each native, but the grower should satisfy himself by occasionally taking hold of two or three of the larger leaves of the plant between his finger and thumb and giving a gentle pull upwards. If the plant does not shift, it means that the soil around it has been pressed down properly.

A few days after transplanting, gaps will be observed in the field due to plants having died as a result of inherent weakness in the plant itself or to adverse climatic conditions or to depredations by insects. These gaps should be refilled as soon as possible, because the more perfect the stand the greater the financial gain. Refilling should not be delayed more than a few days after transplanting has been completed, because otherwise the refills will be considerably more backward than the original plantings and so result in unevenness in time of ripening.

Cultivation.—Cultivation should commence as soon as the plants have become established in the field. The first cultivation should be shallow and carried out by hand so that the young plants will not be injured or disturbed. Later on a single tine cultivator may be employed, but its use must be discontinued as soon as the plants have grown out a bit and the leaves are liable to get damaged. Subsequent cultivation should be shallow and done by hand. The field should at all times be kept free of weeds and a light surface mulch should be maintained to reduce loss of soil moisture by evaporation and to allow of satisfactory aeration of the soil.

The drawing of soil to the stem of the plants at each cultural operation is also important, since it allows of more plant food being placed within easy reach of the feeding roots.

All cultivation should cease as soon as the plants begin to come into flower, as disturbing the plants after this stage will delay maturity and cause dust to adhere to the leaf.

Priming.—The lowest leaves on tobacco plants are too thin and papery to ever cure into good quality tobacco, also they are an imminent source of danger, because being near the ground they attract insects, and it has also been found that diseases generally commence in them and then spread to the higher parts of the plant. Furthermore, the food materials translocated to them would be used to far greater advantage by leaves of better quality borne higher on the plant. For these reasons all lower leaves which tend to touch the ground should be removed or "primed" off.

The operation should be delayed until about a month after transplanting, as this period gives any disease which may be developing in the leaf time in which to make itself apparent and so enable the grower to avoid transmitting it by hand to healthy plants.

It is always good practice to send through the field a gang of labourers whose duty it is to remove diseased leaf only. They should receive implicit instructions not to touch healthy plants. They are immediately followed by another gang who prime only healthy plants. In this way the possibility of spreading infection by hand from diseased to healthy plants is reduced to a minimum.

Topping and Suckering.—Turkish type tobacco does not require to be topped.

It is unusual for suckers to make an appearance, but in certain seasons of heavy rainfall, particularly at a time when the plants are reaching maturity, it sometimes happens that they do appear, and when this occurs, it is necessary that they be removed.

(*To be continued.*)

FOR TOBACCO GROWERS.

"Diseases of Tobacco in Southern Rhodesia" (1931) and Supplement I. (1939) is issued by the Department of Agriculture, and contains most of the available information on local tobacco diseases. 136 pages, 7 coloured plates, 33 photographs and 15 figures. Obtainable from Herald Stationery Store, Salisbury, price 5s. 8d. complete, post free. Supplement I. only, 1s., postage 2d.

FOR ALL FARMERS, VEGETABLE GROWERS AND GARDENERS.

"A Descriptive List of Plant Diseases in Southern Rhodesia and their Control." (December, 1939). Over 600 diseases listed. 51 pages. Obtainable from the Government Stationery Office, corner 4th Street and Central Avenue, Salisbury, price 1s.

The Wintering of Weaners on "LIME RIDGE"

By P. E. N. Nicolle, Barkly Estate, Hunters Road.

Feeling that the only way to produce really good chillers at the right age was to feed them as weaners and thereafter each winter, we decided to establish a weaner feeding section. This we have done on the farm "Lime Ridge," in the Hunters Road district.

I was careful when selecting the farm to bear in mind the following points: that unlimited hay could be cut with little or no expense in the preparation of the hay fields; secondly, that there was ample arable land available; and thirdly, that there was a good water supply. I would like to stress the importance of the first consideration, for it is only when one has fed a large number of cattle that one realises the amount of hay they consume and the quantity required for making manure and compost.

Our pens are very simple and easily made and hold in all approximately 450 weaners. They are of mopane poles with four strands of wire cable threaded through each pole. The feeding troughs are made from cyanide drums which were flattened out and the sides bent up, after which they were riveted together lengthways. A feature I adopted with these pens was the placing of the feeding troughs outside the pens in the central passage-way as may be seen from the illustrations. There are two gum-poles running parallel with each other, the first is two feet from the ground and the next eighteen inches from the first, the trough is then nailed on to the bottom gum-pole with short supports on the outside. The idea is that the cattle put their heads through the poles to feed. This method has a lot of advantages, it protects the troughs from being broken down or damaged by the beasts and tends to keep the cattle in better position when feeding; also it makes the feeding of concentrates much easier.

Our weaners are being fed on cubes, sunnhemp hay and veld hay in the following quantities per day: 1½ lbs. of cubes, 4 lbs. of sunnhemp hay and unlimited veld hay per steer. Details showing what it has cost to feed these weaners are given below.

All the weaners have been railed up from our Ranch at Gwanda; their average age is twenty months. They were brought up in June. Unfortunately, owing to our pens not being completed they were not put in until July. However, this will not happen again, and it is my intention in future to have them all in the pens by the first of June. They will remain there until after the first rains, when the new grass is sufficiently advanced. They will then be given free range during the summer months until the following winter, when they will be brought into the feeding pens at Barkly Estate, where they will be finished off as chillers.

It is too early to say yet what the ultimate results will be, but I, for one, feel quite confident that these are the only lines on which we can hope successfully to build up our chilled beef export trade.

Total cost of feeding 450 *weaners from the* 1*st July to* 30*th September*, 1940.

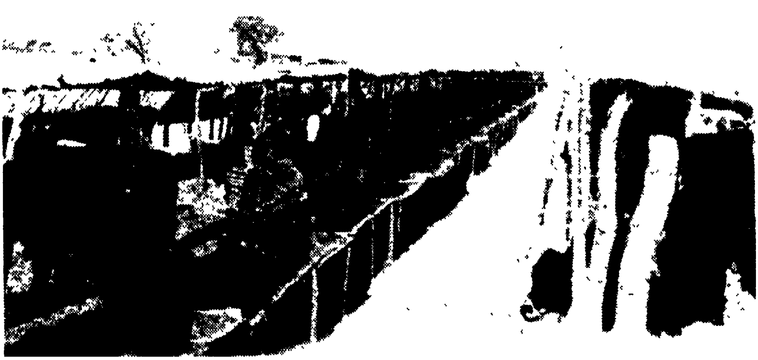
Native labour, 4 boys in charge of weaners......	£8	8	0
Native rations for 4 boys in charge of weaners	6	0	0
Labour for chaffing sunnhemp	0	12	6
Oil used for pumping water and chaffing sunnhemp	3	15	0
Cost of cubes @ 1d. per lb. feeding 1¼ lbs. per day	258	15	0
Sunnhemp @ 10s. per ton feeding 4 lbs. per day	43	2	6
	£320	13	0

I have not taken in costs of veld hay, which can be offset against the value of the manure.

Total cost of erecting pens, capable of holding 450 *weaners.*

Native labour	£12	1	2
Native rations	9	0	0
Cyanide drums @ 1s. 6d. each	8	5	0
Gum poles	12	3	0
Wire cable	2	10	0
No. 8 plain wire	1	13	6
½ inch nuts, bolts, washers and rivets, etc.	7	10	0
	£53	2	8

Mopane poles were cut on farm, the only costs being labour and cartage.



The Farm Home

Preservation of Food

By Miss E. E. Coutts.

In the coming months there will be an abundance of fruit suitable for preserving. Under these circumstances it might be advisable to consider what preservation of food implies. Many people are apt to forget there are numerous ways of preserving and that each has its advantages. The object of preserving is to keep in good condition for a long period. There are four points of interest with regard to this:—

1. The keeping quality of food.
2. The decomposition of food and its causes.
3. The different methods of preservation.
4. The food value of the food when preserved.

The first of these may be divided as follows:—

(*a*) Perishable foods, including all soft juicy fruits, meat, poultry and vegetables.

(*b*) Semi-perishable.—Apples, pears and various root crops.

(*c*) Non-perishable.—Grains and cereals when stored correctly.

The decomposition of food is due to the following:—

1. Moulds (living organisms).
2. Yeasts (living organisms).
3. Bacteria (living organisms).
4. Enzymes (chemical substances).

1. *Moulds.*—The most familiar of these agents. They are visible to the naked eye; thrive in damp; require a certain amount of warmth and if air is stagnant grow easily. They are readily killed at temperatures over 165° F.

2. *Yeasts.*—Not visible to the naked eye. Live on sugar or jam, etc., and cause fermentation. Killed easily at 154° F.

3. *Bacteria.*—The control of these is difficult and is the problem of the commercial trade. They grow best in non-acid medium, therefore the preservation of fruit is not such a problem here. Vegetables lack acid and therefore the problem of dealing with bacteria in this case becomes acute. In addition bacteria are found in large numbers in soil, and vegetables can become contaminated easily.

4. *Enzymes.*—Chemical substances found in fruits and vegetables which cause changes to take place without changing themselves. They work at a temperature between 80°-110° F., but are destroyed at 165°. They are the agents which cause fruit to ripen, etc. One very familiar action of enzymes causes an apple to become brown when cut.

The effect of these agents on food is as follows:—

Moulds.—Not harmful, but if allowed to continue to grow the food becomes unpleasant and not fit for food. Appearance is spoilt.

Yeast.—Flavour is spoilt; food ferments and becomes unfit for food.

Bacteria.—Usually harmful. Some may produce poisons; always cause unpleasant smell, bulging cans, flat sours, etc.

Enzymes.—These give discolouration, particularly in the case of bottled fruit when fruit is left out of syrup.

Moulds, yeasts and bacteria, like other living organisms, in order to develop require warmth, moisture and food; if one of these is removed they remain dormant but will develop when conditions are again favourable.

Food may be preserved in the following ways:—

(*a*) By destroying all living organisms by heat, *e.g.*, sterilising or preserving fruit in syrup.

(*b*) by excluding air and living organisms altogether, *e.g.*, preserved eggs.

(*c*) By depriving the living organisms of warmth, *e.g.*, cold storage treatment.

(*d*) By removing all moisture from food, *e.g.*, drying of fruit, vegetables and biltong.

(*e*) By treating with substances which retard growth of organisms, *e.g.*, vinegar in pickles, salt in curing.

(*f*) By using a combination of any ot the above.

In the next few issues it is proposed to give hints on the different methods of preserving used in the home, *e.g.*, fruit juices, jam, bottling, drying, etc. The first of these is included in this issue.

FRUIT JUICES.

These may be made from all juicy fruits except strawberries, which have not got sufficient flavour. Fruits which are too ripe for other methods of preserving may be used.

Method.

1. Fruit like loganberries should be heated very carefully to extract juice. Place in double earthenware saucepan or put in china bâsin standing over hot water.

2. Never use any metal or enamel pan.

3. 6-7 lbs. is as much as can be done conveniently.

4. No water is added.

5. Use wooden spoon and break up fruit as much as possible beforehand. Juice of oranges and lemons should be squeezed out.

6. Strain through jelly bag or linen cloth overnight (no metal basins).

7. Squeeze lightly. It spoils colour to press hard.

8. Bottle at once if liked, or a better flavour is obtained by adding sugar. Proportions: ½-¾ lb. sugar to 1 pint juice (depends on individual taste).

9. Stir in without boiling.

10. Leave to stand before bottling.

11. Strain through muslin.

12. Bottle (bottles should not be too large).

13. Pour in to within one inch of where cork will go. (If clip is used do not force down).

14. Put corks in hot water half an hour before using to clean and make pliable.

15. Push in as far as possible and keep in position during sterilising (cut a square of calico and tie over cork or use wire).

16. Place in steriliser—bottles standing upright and water up to neck of bottle, or use large pan with good pad of old newspaper at bottom. (Bottles must not touch each other or bottom of pan.)

17. Use cold water and bring to 170° F. in 1 hour; keep at that for half an hour. (Simmering point.) If water boils a shorter period will sterilise, but colour will not be so good.

18. Remove from steriliser and cool as quickly as possible. Bottles should stand on wood out of draught.

19. Cover cork completely with melted paraffin wax or sealing wax to make airtight.

Use of Fruit Syrups.

1. To make cooling drinks with water or soda water.

2. To make drinks with hot water in winter and in treatment of colds.

3. To make table jellies with addition of water and gelatine.

4. To make sauces.

5. To make trifles (cake soaked in juice).

6. To flavour ices and cake fillings.

7. To make a type of cream with addition of gelatine and custard or gelatine and unsweentened tinned milk or cream.

Annual Report of the Agriculturist

FOR THE YEAR ENDING 31ST DECEMBER, 1939.

By D. E. McLoughlin, Agriculturist.

Season and Crops.—The season was very unfavourable for most summer crops and was marked by an unusually heavy rainfall. The lateness of the opening rains with heavy and continuous rains throughout December severely handicapped planting operations. Much of the maize planted on low-lying land succumbed as a result of constant rains. The rains in January were continuous up to the middle of the month, when the first break in the weather occurred. The maize made a good recovery and the crop was most promising by the end of January. With the return of the rains, hopes of a good crop were dispelled early in February, the precipitation in Salisbury, for the month, was 16.77 inches, which is only .04 inches less than the record established in 1907. Bulawayo established a record with 13.52 inches. Further heavy and constant rains in March, coupled with the unusual lack of sunshine, caused most soils throughout the main arable farming areas to remain cold and water-logged with the result that crop growth suffered severely from lack of nitrogen. Heavy floods occurred in many districts and much damage was done to cultivated lands. Conditions were most unfavourable for hay-making and in very many cases farmers were unable to preserve grass in the form of silage owing to the high water level which resulted in the flooding of pit silos. The exceptionally adverse seasonal conditions were reflected by a greatly reduced maize crop. The areas least affected were Hartley and Matabeleland, which incidentally produced a larger crop than in the previous season.

Maize.—The total European acreage planted, according to figures supplied by the Government Statistician, was 265,942 acres as compared with 276,260 acres in 1937/38. The total production was 1,209,818 bags, or 4.55 bags per acre, as against 1,432,003 bags, or 5.18 bags per acre in the previous year.

The Mazoe district produced 383,022 bags, or 5.61 bags, as against 7.2 bags per acre in 1937/38; Salisbury 241,395 bags, or 4.64 bags, as against 6.7 bags; Lomagundi 113,127 bags, or 4.24, as against 176,332 bags, or 5.7; and Hartley 167,843 bags, or 5.73 bags, as against 116,636 bags, or 3.7 bags in the previous year.

The production in Matabeleland was 159,643 bags from 46,747 acres, or 3.42 bags per acre, compared with 108,935 bags, or 2.29 bags per acre, in 1937/38.

Ground Nuts.—The yield per acre was 2 bags less than in the previous year and the production of 37,207 bags or 6.8 bags per acre would have proved insufficient for local requirements, but the larger crop of native grown nuts should obviate the necessity of importation.

Sunflowers.—Production was greater by over 4,000 bags compared with the previous year. Sunflower was in great demand and found a ready market overseas at a remunerative price. The demand greatly exceeded the supply, as was the case in the previous year.

Wheat.—The season was a very favourable one for wheat on moisture retaining "vlei" lands. The heavy and late summer rains provided ample moisture to bring crops to full maturity. The incidence of rust was mild and frosts caused very little damage. Adequate supplies of water for irrigation were available and a record crop is expected. Losses of grain were occasioned by exposure of stacks to rain, owing to the breakdown of one itinerant threshing outfit. A shortage of native labour also hampered harvesting.

Seed Potatoes.—During the year efforts were made in conjunction with growers of main crop potatoes and members of the Potato Pool to bring about the formation of a Seed Potato Association. A committee consisting of the Manager of the Farmers' Co-operative Society and four members of the Potato Pool was appointed to investigate the scheme and to consider the draft constitution prepared by the Branch.

The main objects are (1) to provide for the supply to farmers of sound reliable seed potatoes of high standard, under the guarantee of the Association; (2) to assist members to dispose of their seed potatoes; (3) to promote the more general use by farmers in Southern Rhodesia of certified seed potatoes grown in the Colony.

In view of the possibility of the war affecting supplies of stock seed from Great Britain, experiments in the growing of seed potatoes have been commenced on the Rhodes Inyanga Estate, in co-operation with the Conservator of Forests. Twenty cases of Scotch certified N.1.(A) seed of the Up-to-date variety, and four cases of two other varieties, imported by the Farmers' Co-operative Society, Ltd., are under trial. The object of the experiment is to ascertain if the present rapid degeneration of imported seed caused by virus diseases can be checked by rigid selection and rouging of successive crops.

Agricultural Shows.—Officers of the Branch attended and judged at all the Agricultural Shows held during the year. The quality of the produce exhibited was well up to standard, especially the maize, despite the bad season. The maize classes on the whole were well supported, but there was a general fall in the entries of other farm produce and a real effort requires to be made by Show Societies to stimulate interest in this section. An innovation was the introduction by the Branch of the new fifty ear "Utility" maize class, of which forty ears are unhusked. This class was keenly contested at Bindura and provided seventeen entries. Efforts are being made to introduce additional classes to provide a better balance in the art of selection between the expert exhibitor and the novice and to stimulate greater competition. It is further hoped that the Utility Classes will promote interest in field selection of seed maize and thus ensure the use of better seed. The supply of seed maize again fell short of requirements, and it is a matter of grave concern that seed merchants and farmers resorted to the screening of commercial maize for planting. The practice results in crop failures and the spread of diplodia. The formation of a Seed Maize Association to cater for the supply of certified seed is long overdue. Past efforts to bring into being such an Association met with little support from maize growers. The matter is, however, being considered by a few leading growers and it is hoped the scheme will materialise.

Maize Export and Grading.—Owing to the very unfavourable season 1938-39 no maize was available for export. Nevertheless, owing to delay of the decision regarding export, it was necessary to maintain a small staff or graders from mid-July until the end of August, in the event of their services being required. Mr. L. C. Roberts again acted as Senior Grain Inspector, and Mr. J. J. Erasmus again acted as Temporary Grain Inspector.

Compost.—The manufacture of compost is spreading rapidly throughout the Colony, both in Matabeleland and Mashonaland, probably largely due to the uniformly excellent results from its use obtained by those farmers who have made and used it during the past two seasons.

The greatest responses to its use have been obtained on poor sandy soils, and (from maize) on those heavier soils which are severely infested with witchweed. In the latter case evidence is accumulating which indicates that compost made with animal dung and urine enables the maize plant to defend itself against the attack of the parasites. A note on this phenomenon was published in the *Rhodesia Agricultural Journal* during the year, and it is being further investigated on the Witchweed Demonstration Farm in the Mazoe Valley.

Whether this evidence is confirmed or not, it seems clear from the recorded experience of four farmers that the greatest returns from its use by the maize farmer will be obtained by applying it to maize grown on soil severely infested with witchweed. One farmer under such circumstances obtained an increased yield of maize of approximately 14 bags per acre from a dressing of about 10 tons per acre, as compared with the same soil not receiving compost.

A considerable number of tobacco growers are testing its value for this crop during the 1939-40 season, both for use on the seed-beds and in the field, and it is to be hoped that their experience will confirm the very encouraging results obtained by the two or three pioneers. If it does, then there appears to be a very large field for its usefulness in reclaiming the large areas of exhausted tobacco soil to the continued cultivation of this crop.

As illustrating the continued widespread interest in the making of compost it may be mentioned that the 4th edition of the Departmental Bulletin on the subject, which was published in April, 1939, was exhausted in July. A 5th edition of this Bulletin (No. 1136) was then published and is now available.

The Witchweed Demonstration Farm—Whitecliffe.—This was opened early in the new year, but unfortunately the late start and the delay in obtaining implements and oxen made it impossible to plant any crops during the 1938-39 season. This entailed the unforeseen necessity of purchasing foodstuffs during the latter half of the winter in order to maintain the oxen in working condition. Had this not been done the programme of work for the present season could not have been carried out.

The main object of this demonstration farm is to demonstrate the methods of controlling the parasite advised by this Division, and to bring the farm back to a condition where economic production is possible. Subsidiary projects are given in the following list:—

(1) Rotation of crops to raise soil fertility and temporarily reduce the area of land under host crops, such as maize;

(2) The use of broad-base contour ridges to enable them to be kept free from the weed hosts of witchweed by mechanical cultivation;

(3) The use of broad-base contour ridges to enable mechanical check-row planting of maize in order to economise hand labour;

(4) Wide spacing of maize by machine and by hand in order to economise hand labour by permitting the use of mechanical cultivation throughout the growing season;

(5) The use of various implements for cultivation between wide spaced rows of maize;

(6) The use of animal draught for all-season cultivation for normally spaced maize;

(7) The use of trap-crops for witchweed control;

(8) Testing the practicability of "triple-trapping"—that is growing three trap-crops of Rhodesian Sudan in one season, and killing the first two by disc harrowing;

(9) The use of compost for soil amelioration and improvement in the methods of making it;

(10) Investigation of compost as a defence against witchweed;

(11) The composting of the green-manure crop;

(12) To investigate the value of various mixtures of other green-manure crops with sunnhemp for composting;

(13) The improvement of the pastures by sowing Paspalum dilatatum and Rhodes grass, and testing the value of certain legumes;

(14) The provision of witchweed-free pasture to prevent the parasite being spread by the working oxen;

(15) The use of rubber-tyred vehicles;

(16) The value of the electrified wire fence for rotational grazing, etc.;

(17) The practicability of fattening sheep on summer oats rotationally grazed, and its effect on witchweed and soil tilth;

(18) The value of Wintersome-horse gram mixture for silage;

(19) The making of veld grass silage;

(20) The trial of new types of machinery and implements for witchweed control and other purposes, and the improvement of existing implements;

(21) The use of head-yokes versus neck-yokes on draught oxen;

(22) To find the cost of various methods of control and other farm operations.

(23) Control of the parasite in the wild pastures in order to prevent its spread by working oxen.

The acreage of the farm which it is possible to put under the plough is approximately 408 acres. Of this acreage approximately 50 acres are being laid down under improved pastures of Rhodes grass and Paspalum dilatatum. A further proportion of land which consists of sticky black soil bordering the vlei, which is found this season to be unsuitable for cropping, will also be laid down to Paspalum dilatatum in the future. Approximately 15 acres is under Rhodesian Sudan for seed production.

The rotation of crops which is at present in use is as follows:—

(1) Trap crops, and green manures to be composted.

(2) Maize for grain and Wintersome for silage—receives 200 lbs. per acre of rock and super.

(3) Maize+compost and 150 lbs. of rock and super per acre.

(4) Legume hay—ground nuts—sunflowers—sunnhemp for seed.

Outside the rotation approximately 5 to 6 acres of land are being placed under sweet potatoes, Napier fodder and a Vi-Vi and Rhodes grass mixture.

A few acres (3 to 5) are being sown with summer oats (S.E.S.) to be rotationally grazed with sheep to be fattened.

During the winter excellent progress was made with the protection of the soil from erosion, and some 16 miles of broad-base contour ridges have been constructed over which no difficulty has been experienced in planting and cultivating.

It is of particular interest to note that it has been proved feasible to check-row plant maize by machine over these contour ridges.

Another matter of some importance is that the value of tripods for curing legume hay in wet weather was well demonstrated. A self-sown crop of velvet beans was cut in the morning and placed on tripods in the afternoon. During the weeks the hay was on the tripods over 4 inches of rain fell in heavy showers, and the hay suffered no damage except for the bleaching of a thin layer outside. In the interior of the cocks the hay was of an excellent colour and quality.

Witchweed Control.—The following extracts are quoted from the report of the Assistant Agriculturist:—

"The opening of the 1938-39 cropping season was marked by heavy and continuous rains, which carried on with hardly any intermission throughout the season. These conditions are very unfavourable to the germination of the parasite, and thus the amount of witchweed appearing above ground was again much restricted, as was the case in the previous season. This assists the farmer temporarily by giving him a respite in controlling the parasite by cultivation, yet he must bear in mind that the seed which remains ungerminated in the soil may retain its viability for many years, until conditions favour it. He cannot therefore afford to abate his vigilance against the parasite."

Unfortunately these same conditions militate against the efficiency of trap-cropping, and also make the work of ploughing under the traps difficult.

Trap-Cropping.—The following table of figures kindly supplied by the Government Statistician shows the acreage reported by farmers to have been trap-cropped. The decline in the current year was no doubt due to the excessive rainfall which was particularly severe in the Mazoe Valley:—

Year.	Acreage under Trap-crops.
1932-33	1,445
1933-34	1,796
1934-35	2,208
1935-36	2,188
1936-37	3,003
1937-38	3,091
1938-39	1,811

The trial of triple-trapping with Rhodesian Sudan grass carried out with the valued co-operation of Mr. A. W. Laurie on his farm Howick Vale, has supplied valuable information concerning this new system of control. Unfortunately the excessively wet season experienced (Mr. Laurie was particularly unfortunate in this respect) made it impossible to judge by the amount of the parasite seen above ground which system of trapping had been most effective in killing it. Very little was seen, and the maize showed no effect ascribable to witchweed. It would appear, however, from the experience gained in this trial that triple-trapping with Rhodesian Sudan is feasible, where the soil is not too "sticky' in texture. And, where the severity of the infestation does not call for the use of three trap crops in one season, a crop of sunnhemp may follow two traps. This may prove the more suitable procedure in most cases, since the legume tends to correct any tendency to nitrogen-starvation which might be caused by the trap-crops.

It was clearly demonstrated in this trial that Rhodesian Sudan grass is very much more easily killed than Amber Cane or kaffir corn, and that it will make better growth under very wet conditions than Amber Cane. In this trial Rhodesian Sudan grass was killed satisfactorily by double disc-harrowing, when it was over 5 weeks old from germination, and despite the soil being fairly wet. The succeeding crop was sown before the second disc-harrowing which covered it, and an excellent stand was obtained.

Wide-spacing of Maize to save Labour.—The shortage of labour is a serious threat to the maize farmer who is endeavouring to control witchweed, and it is very necessary that all mechanical means possible for killing witchweed in the maize crop should be used. For this reason this Branch has urged on farmers the practice of planting their maize with a spacing of six feet between the rows. Where hand-planting is done the spacing between hills in the rows should be 18 inches with the plants thinned to two per hill. A few farmers tried this method last season and found it very helpful, since it allowed mechanical cultivation all through the season. It is being demonstrated this season on the Witchweed Demonstration Farm near Whitecliffe, and it has been found that two fencing standards attached to a section of a spring-tooth harrow to serve as handles enables this implement to be worked very close up against the rows of maize, leaving very little hand weeding to be done in the rows. Check-row planting by hand at six feet by 18 inches proves much quicker than at three feet by three feet; and 14 boys planted over 14 acres in one day. No fertiliser was applied, of course.

Effect of Compost.—Further confirmation of the inhibitory effect of compost on witchweed has been forthcoming. Four farmers have noted a great reduction in the amount of the parasite appearing above ground where compost was applied to the maize crop and a marked increase in yield of maize.

In the case of the initial experiment carried out on the farm of Mr. C. Tapson, at Concession, for the second year no witchweed was observed on the composted area, and maize again thrived despite late planting and excessive rainfall. The parasite appeared in quantity on the uncomposted land next to the treated area. No further dressing of compost was applied.

This phenomenon is being carefully investigated on the Witchweed Demonstration Farm during the current season, as it is obviously of great importance to the maize farmer."

Wheat Variety Trials on Rubenvale, Umvuma.—These variety trials have now been in progress for six years. They are sited on ordinary sandy vlei soil, which is not irrigated, on the farm of Mr. E. G. Raubenheimer, to whom our thanks are due for his continued co-operation and care of the trials.

In the first variety trial (1934 to 1937) the variety Punjab 8a headed the trial, and it has been included in the second variety trial to serve as a basis of comparison with nine other varieties. The trial is designed in the form of four randomised blocks of 10 varieties.

During the current season the soil received a dressing of well rotted compost and 300 lbs. per acre of complete fertiliser. The moisture supply of the soil was favourable owing to the heavy and late rains of the previous summer.

The rate of seeding was 80 lbs. per acre (broadcast) for all varieties.

Variety.	1938.	1939.	Mean yield 2 years.
Punjab 8a	9.18	14.97	12.45
Sabanero	6.63	17.34	11.99
122 D.I.T.L.	9.35	14.52	11.95
B256b1A	7.90	14.56	11.26
Granadero Klein	7.41	14.31	10.88
N.B. 230A	9.07	12.29	10.68
58 F.L.I.	6.20	14.11	10.18
131C5P	6.85	13.20	10.05
Renown	6.73	12.39	9.60
Florence	6.20	10.84	8.54
Mean yield of all varieties	7.55	13.86	10.64
Standard error	0.77	0.86	0.56

Analysis of Varieties of the two years.

Due tc	Calculated value Z.	Observed value Z at 1% point.
Blocks	0.8232	0.5687
Treatment	0.7276	0.5189
Season	2.8732	0.9784
Season Treatment	0.5888	0.5089

The statistical analysis shows that the results to date are clearly significant, both in the individual years and in the two years' combined results. A difference between variety yields of three times the standard error may be taken as being significant.

Conclusion.—It will be seen therefore from the mean yields for the two years that Punjab 8a, Sabanero and 122 D.I.T. have yielded significantly more than the last four varieties in the table, but they have not yielded significantly more than the remaining three varieties.

The effect of season is particularly marked, and is well illustrated by the very large increases in yield from 1938 to 1939 of the late-maturing varieties Sabanero, 131C5P and 58 F.L.I. This is, no doubt, largely due to the fact that the plentiful moisture supply has enabled these three varieties to reach maturity in 1939, whereas in 1938 they were handicapped by the failure of the moisture supply before full maturity could be attained. This great effect of season emphasises the necessity for continuing a variety trial for a number of years.

The very high yields recorded in 1939 are noteworthy, the mean yield of all varieties being nearly 14 bags per acre, and the highest yield 17.34 bags per acre. These yields are probably due in part to the unusually good moisture supply, and in part to the effect of the dressing of compost. In connection with the latter it may be mentioned that irrigated wheat dressed with 8 tons per acre of compost and 200 lbs. per acre of complete fertiliser on reddish sandy loam at the Plant Breeding Station at Salisbury, yielded at the rate of over 22 bags per acre.

Extension Work in Matabeleland.—At the request of the Matabeleland Farmers' Union two tours (in June and September) were made by the Assistant Agriculturist during the year, of some 60 farms. A previous tour had been made in November, 1938.

Advice was given on numerous matters of field husbandry, and the impression was gained that there is a real desire awakening amongst farmers in that area of the Colony to improve their methods of crop production.

Co-operative Wheat Trials.—A comprehensive tour of the wheat districts—Enkeldoorn, Umvuma, Felixburg, Gutu, Fort Victoria, Melsetter, Cashel, Odzi and Rusape—was undertaken by the Plant Breeder in September. Referring to the new varieties of wheat under trial the Plant Breeder states:—"It was not possible to visit all the farmers to whom wheat samples were sent as the tour would have occupied several weeks, but representative farms were visited in each area and valuable information was obtained as to how the different varieties are behaving.

It is as yet too early to say whether the new varieties will maintain their rust resistance, but as all varieties which have been sent out have proved far more rust resistant than such varieties as Karachi, Punjab 8a, Kenya Governor, Quality, etc., on the Plant Breeding Station over a number of years, it is hoped that they will maintain their rust resistance.

It is very pleasing to note the behaviour of the new rust resistant varieties in the Cashel district. Rust in this district is particularly severe and such varieties as Kenya Governor and Punjab were red with rust, whereas the rust resistant varieties were growing adjacent with no sign of rust.

Unfortunately the most highly rust resistant varieties are late in maturing, being as much as ten days to a fortnight later than such a variety as Punjab 8a.

Selections and crosses are being made on the Plant Breeding Plots to try and get earlier maturing strains of these varieties and crosses between these late maturing rust resistant varieties and earlier maturing heavy yielding varieties.

As far as the Cashel area is concerned the position was that normally it was almost impossible to get a crop of wheat with the other varieties, whereas with the new varieties I saw some very good crops.

The following are the most rust resistant varieties of wheat in the order mentioned:—1. Granadero Klein (late); 2. 122.D.I.T.I. (late); 3. 131 C.5.P. (late); 4. 58 F.L.I. (late); 5. Sabanero (late); 6. Beltista (fairly late); 7. Pilgrim (fairly late); 8. N.B.230 A 14 (L) (fairly early, about 8 days later than Kenya Governor); 9. B.256b.I.A.64 (L) (as for NB 230 A.14 (L); 10. Kruger (early)."

PLANT BREEDING STATION: HILLSIDE.

Maize.—Twenty acres were planted to the new hybrid maize and twelve bags of seed were selected for planting on the Station and for distribution to farmers. In spite of the heavy rains the grain was remarkably sound. Samples were submitted to the Senior Plant Pathologist for diplodia tests. The best sample, a flinty type, returned a germination of 99% and only 2% of the grains were infected with diplodia. Rigid maize breeding for resistance to diplodia, etc., has been continued. Selfed selections as well as selections from the main crop have been made.

Rice.—Twelve varieties of rice were sown on vlei land. The varieties made good vegetative growth but set no grain. The same varieties grown under irrigation failed entirely.

Winter Cereals.—Two hundred and fifty-six varieties, selections and crosses of wheat, and nineteen of barley, were under trial and a considerable number grown in the previous season were discarded. The crosses made in 1933 were bulked up for distribution next winter. During the past eight years some 3,059 wheats have been tried out. A yield equivalent to 22 bags per acre was obtained with a new wheat Granadero. One hundred and ninety-one samples of wheats weighing 2,515 lbs. were distributed to 41 farmers.

Improved Pastures.—Increasing interest is still being evinced by farmers throughout the Colony in this matter, and the two grasses chiefly being utilised are Rhodes grass and Common Paspalum, since these two grasses are the only ones which are at present known to be suited to local conditions for summer pasture, and of which at the same time seed is commercially obtainable. Farmers are undoubtedly averse to propagation of grasses from roots or runners, and for this reason there seems little prospect of extensive establishment of pastures by this method.

Paspalum has proved itself an extremely hardy grass on moist soils, and of great value for pasture, but Rhodes grass is not a hardy grass and requires good soils and good treatment to ensure its reasonable permanence. Under the latter conditions it is a valuable hay and pasture grass.

The possibilities of renovation or improvement of natural pastures by cultivation is being investigated in co-operation with farmers in Matabeleland.

The feasibility of utilising the moisture retained in the Kalahari ("Gusi") sandy soils of that area by sowing winter-growing cereals and Wimmera Rye grass in late summer to provide autumn and winter grazing for dairy cows is also the subject of co-operative experiments.

Rhodesian Sudan grass is also under trial for the same purpose and supplied grazing throughout the past winter on Kalahari sands. It still remains to be proved whether the grazing of a pure stand of this grass may be poisonous or not, since it is known to contain prussic acid; but the limited evidence at present available indicates that it is a safe pasture. It possesses the great virtue of being winter-hardy, and it is also very drought-resistant.

All down the Eastern border hill country the conditions are very suitable for Paspalum dilatatum, particularly on the sandy loam soils, and there is little doubt that this grass has a big future in this area, particularly on the hill tops and slopes, since they are little affected by frost. Under such conditions this grass will give nine months of good grazing in the year, and a fair green bite during the remaining three months, on the moisture-retaining sandy soils.

Rhodes grass also promises well as a hay and pasture grass, but more experience of this grass under varying conditions is required.

Vlei-land Pasture Demonstration Station: Rusape.—Details of the investigations conducted on this Station are contained in the writer's annual report for 1938. Grazing tests to compare the carrying capacity of indigenous and exotic wet land grasses and the effect of artificial fertilisers on the persistency of clovers and grasses planted in 1937 were continued. Owing to excessive rains during the months of January to April it proved impracticable to utilise the grazing before 8th May, from which date forty-eight adult cattle were grazed on five plots, 2 acres each in extent, for thirty consecutive days. Each plot was grazed for six days, the cattle being allowed out for water only. Plot No. 3, Paspalum dilatatum, was again grazed from the 15th September by 20 head for five days and from the 27th November by 24 head for seven days. The only other plot which was grazed a second time was Plot No. 1, Rhodes plus Paspalum dilatatum. This plot carried 24 head for 2 days in November.

The best results were obtained with Paspalum dilatatum, which provided 278 grazing days for an adult animal under the system of management described. It is conceivable that under ideal conditions of management and treatment an acre of Paspalum dilatatum would provide grazing for 2 adult head for six months in the year from May to October during the period of scarcity of natural grazing. This grass made luxuriant growth and remained green during the winter.

The progressive weakening of Rhodes grass and the poorer growth made due to the excessive rains and waterlogged condition of the land resulted in a poorer return of grazing being obtained with the mixed sowing of Rhodes plus Paspalum dilatatum compared with Paspalum dilatatum alone. The value of Rhodes in a mixed sowing with Paspalum on uniformly moist land can only be ascertained after a period of years. The difference in yield over a two year period is still in favour of the mixture, but it remains to be proved how soon Paspalum can replace Rhodes entirely. As individual granite vleis vary tremendously in degree of wetness and contain areas which dry out in the winter and parts which remain very wet, it is considered that a mixture of Rhodes and Paspalum provides an insurance against the complete failure of one grass under more than one set of conditions. A further improvement in the growth of clovers was made and the plants are spreading as the result of the weakening of Rhodes grass, which proved too aggressive during the first two years.

A dressing of nitrogen in the form of nitro chalk at the rate of 130 lbs. per acre was applied to all plots excepting Plot No. 1 " Fertiliser Trials," which received the usual fertilisers laid down.

Pasture Grass Trials on the Eastern Border.—A small variety test of some 30 different grasses and legumes was laid down on the farm Sheba, near Stapleford Forest Reserve, in co-operation with the owner, Mr. A. C. Soffe, in 1938. This has provided much useful information, but none of it is conclusive, owing to the unavoidable defects of all farm co-operative experiments.

A number of small scale co-operative trials of winter grasses and clovers were commenced in the previous year on farms in the Melsetter district, but they have now been abandoned for various reasons.

Further trials on a somewhat larger scale are being commenced in the same area in co-operation with farmers this summer (1939-40), and also trials of Rhodes grass and Paspalum dilatatum. The Sheep and Wool Officer, Mr. Morrison, is kindly giving valuable assistance with these trials.

At the Rhodes Inyanga Estate some 8 acres of land (red clay loam soil) are being laid down under irrigated pastures under the advice of this Division, and a section of the trial is being devoted to the investigation of untried varieties of grasses and legumes. Some 6 farmers have been supplied with seed of Phalaris arundinacea, Poa compressa and Crested Wheat grass for trial. The seed of these grasses was obtained from America through the kind offices of Messrs. Massey-Harris & Co., of Salisbury.

Some 18 farmers on the Eastern Border from Inyanga to Chipinga have been encouraged and assited to make independent trials of selected winter grasses and legumes, and also of certain summer grasses, the latter chiefly Rhodes grass and Paspalum dilatatum.

These trials, and the advisory tours carried out by the Assistant Agriculturist, have resulted in a great stimulation of interest in the subject of improved pastures amongst farmers down the border, and with regard to winter pastures there is real need for an experiment station under trained supervision in order to supply the authoritative information on the subject which at present is so lacking.

Winter Pastures.—The following comments contained in the report of the Assistant Agriculturist are of interest.

Considerable interest continues to be evinced by Eastern Border sheep and cattle farmers in the possibility of establishing pastures of winter-hardy grasses to provide winter grazing.

The experience of the past three years proves that a number of such grasses can be established on the moisture-retaining soils of the area with ease, but the past two winters indicate that unless they are irrigated, good and plentiful grazing from them cannot be expected during the three critical months of July to September, since the rainfall during this period has proved insufficient. Nevertheless, despite severe burning by drought many varieties of winter grasses have recovered well with the arrival of good rains in October.

However, it would appear that to ensure good grazing when it is most required during July to September, irrigation must be supplied, and on many of the hill farms this can be cheaply arranged.

Winter pastures are costly to establish, and this is an added reason for ensuring their usefulness and permanence by supplying irrigation.

If irrigation is not supplied then it would appear that only the hardier and more drought-resistant grasses offer hope of real success. Among these the drought-resistant fescues (Hard fescue, Creeping Red fescue, Chewing's fescue, Sheep's fescue), Tall Oat grass, and Crested Dogstail are the most promising.

Where soil fertility is moderate (as is generally the case in the area), but moisture is ample, Yorkshire Frog and Red Top (Agrostia alba) have displayed much promise. The former appears to be particularly suited to establishment on virgin soils, and owing to its rapid growth from seed competes with weeds better than other grasses. Red Top also appears to thrive on virgin soils, but is much slower in establishing.

Cooksfoot and Phalaris tuberosa show great promise where moisture supply and soil fertility are ample, but neither of them resist well the competition of weeds during the first season owing to their slow growth and lack of drought-resistance.

The writer does not consider there is much prospect of real success with Perennial Rye grass owing to the unlikelihood of its being sufficiently permanent to warrant the expenditure of establishing it. To ensure its reasonable permanence under Eastern Border conditions it is considered that soil fertility must first be built up by generous dressings of compost or manure and fertilisers and that irrigation is a necessity. This grass usually gives spectacular growth during the first season, but thereafter rapidly declines and dies out if the soil fertility and moisture supply are not both high. It is possible that after the fertility of the soil has been built up under a temporary lay of hardier grasses and clovers for a period of years the Perennial Rye grass may then be sown with success where moisture supply is ample. Wimmera Rye grass promises to be valuable in mixture for providing a quick cover and good grazing in the first year.

Whatever grasses are sown heavy rates of seeding are necessary in order to obtain a quick cover of the ground, in order to check weed growth and soil erosion, two very serious obstacles on the Eastern Border. Protection of the soil against erosion by means of contour ridges, or contour-strip sowings, are also very necessary. Terrible erosion has taken place in certain cases observed by the writer, due to thin seeding, gross over-grazing, and lack of erosion protection work. In no case observed by the writer have winter pastures sown in this area been given a fair chance to establish thoroughly before being heavily grazed. They have been grossly over-grazed during the first winter after seeding, and this has lead to the killing out of the more delicate and slow-growing grasses, and particularly of the white clover which is very slow to establish and delicate in the seedling stage.

In general the soils of the Eastern Border are acid and deficient of phosphate, and in the case of the sandy soils deficient in potash also. In order that clovers may have a chance of success these deficiencies must be made good by applications of lime, phosphate and potash prior to seedling, and the seed must be inoculated with the proper bacteria. Owing to the high cost of transport this is very costly, and the critical question arises as to whether it will be cheaper to supply the nitrogen requirements of the grasses in the form of concentrated nitrogenous fertilisers, or by means of clovers. This question can only be properly answered by long-continued exact experiment, which is quite outside the scope of farm co-operative experiments.

This subject (winter pastures on the Eastern Border) bristles with other lesser, but still fundamentally important, questions which cannot at present be answered, and in consequence advisory work on the matter is very severely handicapped.

In conclusion, it may be pointed out that the problem of supplying winter feed for young stock after weaning (particularly lambs) by means of winter pasture is all the more pressing owing to the difficulty of growing winter reserve feeds such as silage and hay, on account of the very hilly nature of the area and the heavy rainfall."

Agriculture Experiment Station: Salisbury.—The rainfall at this station totalled 51.33 inches, being 70% above the normal amount.

The continuance of experimental work commenced during previous seasons formed the main activity of the Station during the period under review. A report of the most important experiments was published in the July issue of the *Rhodesia Agricultural Journal.*

Problems connected with the maintenance of the fertility of the soil are receiving much attention. They include trials in which phosphatic fertilisers are applied in different quantities, and in different ways, as well as various methods of utilising leguminous crops in rotation with maize, for the purpose of maintaining the land in suitable condition for the production of heavy crops of the chief cereal—maize.

In Experiment No. 35.—Trials over three consecutive seasons have shown that when the sunnhemp crop was ploughed under before the middle of March, the increased fertility resulting from the green manurial treatment was much less than it was on the adjoining plots on which the green manure was allowed to continue its growth for a week or more. The optimum period for ploughing under the green manure crop has been shown to lie between March 21st and April 15th.

In another series of trials the effect of ploughing under the whole of the green-manure crops in the raw state versus converting the top-growth into compost and returning it to the land in that form, is being investigated. In the same series are plots on which the stubble only of the green manure crop is ploughed under, after the top-growth has been removed for conversion into either hay or compost. Comparison of the effect on the yields of maize of various methods of applying phosphate fertilisers is also being made, and so far it appears that better use is made of the fertiliser when it is placed well down in the soil, than when it is broadcast, and harrowed into the surface layers only. The effect of lime on maize lands is also being investigated. Experiments were laid down some ten years ago to acquire information regarding

Cattle Farming made Profitable

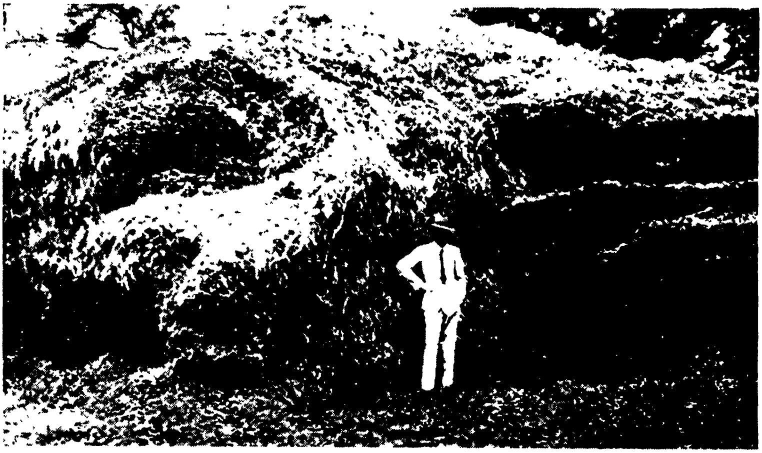


Fig. 1.—The stack yard Rhodes Matopo Estate Experiment Station. Mr. C. A. Murray, Senior Animal Husbandry Officer-in-Charge, standing by an 80 ton stack of cowpea hay beyond which (not shown in this illustration) is a 45 ton stack of sunnhemp hay.

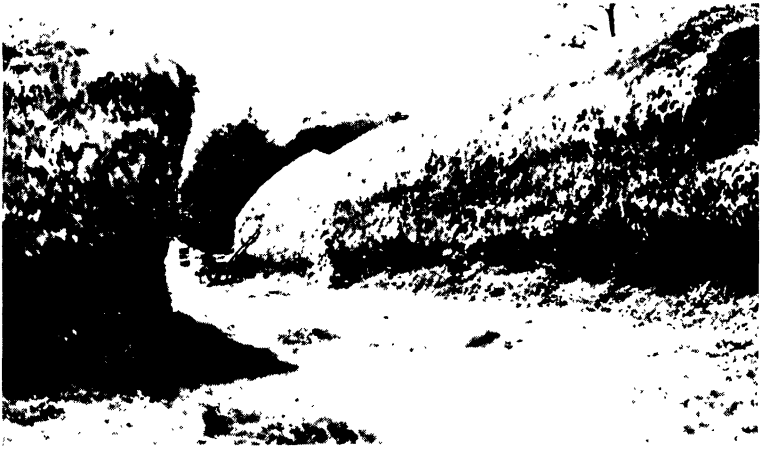


Fig. 2.—Full range of cowpea and sunnhemp stacks illustrated above. The latter has just been thatched to conserve the hay for use next winter. On the left of the picture is a stack of 80 tons of veld grass hay conserved from the previous year.

If more farmers would make adequate provision of winter feed for their cattle and other livestock, losses from poverty would become negligible and the industry would advance to heights of prosperity never yet experienced in Southern Rhodesia.

the effectiveness of green-manuring, and the most economical period which may elapse between its applications. The information gained so far has proved to be inconclusive and a new scheme is being commenced this season in which the various treatments will be replicated a larger number of times, and it is anticipated that more definite information will be obtained for that reason. The humus building ability of short grass leys is also being compared with the more common practice of green-manuring and composting.

Greatly increased yields of maize have been obtained in America and Australia by the use of "hybrid" seed. Such seed is obtained by crossing plants of stock which has been self-pollinated for several generations. We now have forty-four strains which have been selfed for six generations. Hybrids from these were included in our trials this season. Many of these hybrids did not produce better yields than our open-pollinated stock, but a few were distinctly better. These results are similar to those obtained in other countries and there is every reason to believe that as a result of further selfing, crossing, and experimentation, we shall eventually discover the best hybrid combinations to produce, in order that the highly satisfactory results obtained in other countries may be repeated with hybrid seed raised from our own stock. In addition to the 44 strains which have been self-pollinated for six generations, a number of others have been commenced. The parent ears used for the establishment of these were obtained from some of the best of our local growers. A proportion of them were selected from prize winning exhibits. In this way the best material available has been used as the foundation stock for these self-pollinated lines, and it is expected that vigorous, disease-resistant, high-yielding hybrids will eventually result.

Velvet Bean Hybrids.—After commencing with some 500 strains in the year 1935 these have gradually been reduced by the elimination of the less desirable strains until only twelve remain. All these strains produce a much higher proportion of leafy growth than the Somerset variety. The proportion of seed varies very considerably among these hybrids. In some it is half as much as that of the established variety, but in others it is much less than that, and there is some question as to whether the seed production of these light-seeders is sufficient to allow their cultivation to be economic.

Soya Beans: Hay Type.—The object of this work is to produce strains which are capable of yielding as heavy crops of fodder as the standard kinds, but are an improvement on them in that they retain their ripe seed for some three to five weeks before the pods dehisce and the scattering of their contents results. About 30 strains were included in our trials last season, but as the season was an abnormally wet one, and the results varied widely from those of the previous years, it was not possible to decide which were the very best strains, and twelve are being kept for further trial this season. These will be replicated in ten randomised blocks, and it is anticipated that the results will definitely indicate the best three or four strains, and so conclude this line of investigation.

Soya Beans: Yellow-seeded Types.—The seed of these is suitable for human consumption and they are primarily intended for that purpose and for expressing the oil, of which they contain about 18%. The residue forms a valuable concentrate for use as cattle feed. By hibridising a non-shatter type with the varieties Herman and Otoxi, promising hybrids have been procured. In addition to these, strains obtained from the Potchefstroom School of Agriculture have been included in the trials. Some 300 single-plant selections were under trial last season. By the elimination of the least promising ones, the number has been reduced to 75 for trial this season.

New Crops.—Experiments with pyrethrum have resulted in strains which yield flowers in sufficient quantities to warrant trial on a larger scale than is possible on this Station, and seed has been issued to a number of farmers who will be able to give it more extensive trial than is possible here.

Pelargonium Graveolens.—Distilation of the essential oils contained in the leaves of this plant have shown that the quality of the oil is equal to that produced in other countries. Some three thousand cuttings have been rooted with a view to the establishment of a larger acreage from which it will be possible to acquire information as to whether the crop is likely to be a remunerative one when it is grown on a field scale.

The number of parcels of seed issued to farmers and others are as follows:—

Free issues of annual crops to farmers	158
Free issues of perennial crops to farmers	140
Issues to other Experiment Stations in this Colony	44
Issues to foreign Experiment Stations	112
Cash issues to local farmers and others beyond the borders of this Colony	30

Farming Calendar.

DECEMBER.

CITRUS FRUITS.

This is a good month to plant citrus trees in their permanent positions. They should on no account be planted deeper than they stood in the nursery. Water each tree immediately after planting it to settle the soil, then loosen the surface when sufficiently dry to check weed growth and restrict evaporation; continue loosening the surface soil after each rain or watering. If good rains have fallen, disc the grove in two directions, then sow the cover crop and harrow also in two directions. If the grove is weedy it should receive a shallow ploughing in place of the discing. Then sow the seed and harrow the soil. All bearing trees must be kept well watered if the weather continues to remain dry. Trees that suffer for want of moisture while the young fruit crop is developing will be adversely affected, and the crop—if any—will be of inferior quality. Continue to rub off all water shoots or suckers which develop on the tree stems.

CROPS.

Keep the cultivators going, both on planted and unplanted lands, whenever weather conditions are favourable. Destroy the weeds while young and before they obtain a firm root-hold.

Continue planting maize, cotton, beans and ground-nuts as early as possible this month, followed by sunflowers, Sudan grass, manna, pumpkins and cattle melons. Linseed, cowpeas, teff grass, oats, sunnhemp should be planted after the other crops are in. Ensilage crops may be sown at the end of the month. When harrowing maize after planting, this work should be done in the heat of the day when the young plants are flaccid and not easily broken. On lands not yet planted the crop of weeds should be kept down by disc-harrowing. It is a good plan to harrow or disc-harrow immediately before the planter, or alternatively to follow the planter with a light harrow. Treat seed oats for smut before sowing. Use one pint of formalin to 25 gallons of water and steep the bag of seed for ten minutes. Earth up early planted potatoes. Keep a look out for the stalk-borer, and top or otherwise treat affected plants. New lands and old pastures may be broken, as circumstances permit, during December, January and early February, and again ploughed in from May to July. If they carry a heavy crop of grass it should be cut or burnt to enable good, clean ploughing to be done. Sweet potato slips should be planted early in this month. Do not fail to have in a few acres of this valuable crop.

DECIDUOUS FRUIT.

Cover crops may be planted when the rains commence, as recommended under citrus fruits. Summer pruning may be commenced this month. If all undesirable shoots are taken out of the trees, the remaining shoots will receive sufficient air and light to mature. Ripening fruit must be carefully harvested, graded and packed if satisfactory prices are to be secured. Do not gather any fruit when it is wet. Keep all recently planted trees in good condition; the first year's growth is the most important. If the undesired shoots are rubbed off when they first appear, the retained shoots will receive all the nourishment and the tree will then grow to a large size.

FLOWER GARDEN.

This month is generally showery, and constant stirring of the soil is, therefore, necessary to keep it loose. Seeds of perennials and annuals for February blooms may be sown. Transplanting should be done in the evening or on a cloudy day. Carnations should be kept free from dead wood, and climbers attended to.

VEGETABLE GARDEN.

All vegetable seeds may be planted. All advanced plants should be constantly cultivated. Potatoes should be ridged, and peas, beans and tomatoes staked. This is a good month for planting the main crop of potatoes.

FORESTRY.

Final preparations for planting should be made, including harrowing or pitting. Early plantings may be carried out if the season is a good one. Planting should be carried out on dull, rainy days, or failing such days, late in the afternoons. Great care should be exercised in planting out to avoid bending the tap root, and to set the trees in the ground at the same level as they were in the seed bed or tray. Late sowings of Cedrela toona seed may be made.

POULTRY.

The poultry keeper should take precautions whereby the wet weather will not affect his birds' health and their laying powers. All houses must be absolutely watertight, the floor raised well above the level of the surrounding ground, thus preventing water seeping in and making it damp. The birds themselves should not get wet, and no pools of water should be seen in the runs. Foodstuffs also must be kept absolutely dry.

Many birds will at present be moulting; these require special treatment to bring them through it quickly, and if possible keep them in lay during the period. A pamphlet on this can be obtained from the Poultry Officer, Department of Agriculture. This lack of attention to the birds during the moult is one of the causes of the scarcity of eggs at this season. There is no need for it if poultry keepers would only look after their birds properly.

Those who intend disposing of their turkeys for killing at Christmas must avoid cooping them up, as is done when fattening fowls, for they immediately mope and go off their food. Give them free range, and in addition to their usual evening feed of maize, during the first week of December give one of wheat or maize in the morning, and during the second and third weeks three meals a day, each one containing, in addition to wheat or maize, some crushed monkey nuts or sunflower seeds. Plenty of thick milk and chopped-up onions or onion tops should also be given.

Those who go in for ducks should feed well and get as many to marketable size as possible by Christmas, when they usually fetch good prices. They should be kept in a small run; nearly all their food should be wet mash, bran, pollard, maize meal, meat meal and milk, as much as they will eat three times a day, *i.e.*, they should practically be allowed to spend their existence eating and sleeping. Big duck breeders often give a fourth meal by lamplight at 10 p.m., and the first meal is given at sunrise.

STOCK.

Cattle. Feeding should be continued on the same lines as in November. Keep a close eye on any store bullocks that have been selected for fattening on grass.

Ranching cattle should not require any attention beyond dipping. Every effort should be made to have all the female stock in good condition for the breeding season.

Milch cows should be protected as much as possible from cold rains and hot sun. Yarding at night in a clean kraal provided with a simple lean-to shed well bedded up will be found to be very beneficial in seasons of protracted rainfall. The calf-pen should be kept clean, dry and sweet, and young calves will be better kept in during very hot or very wet weather.

Sheep.—Graze on the higher lands, keeping the kraals clean, dry and airy, and watch for ticks. Take out the rams at the end of the month.

DAIRYING.

During the months of December and January veld grazing is usually plentiful, and very little extra feed in the form of concentrates is required for dairy stock. It should be borne in mind, however, that heavy milking cows are unable to satisfy their requirements for milk production from veld grazing alone, and should receive a daily allowance of grain; the latter should be fed at the rate of 2 lbs. for every gallon of milk produced daily, *i.e.*, a cow producing three gallons of milk should receive 6 to 7 lbs. of concentrates. An excellent mixture for this purpose is one consisting of four parts maize-meal and one part ground-nut cake.

During wet weather, the provision of a clean dry shelter for calves is essential; the latter should not be crowded together in a small, damp, badly ventilated pen or muddy kraal. When treated in this manner, a calf is very liable to contract various ailments such as scour, etc. Scour is entirely preventable, and is usually caused by over-feeding, or feeding from dirty pails, feed boxes, etc. Calves which contract scour should be isolated, the milk ration reduced, and they should be dosed with a few tablespoonfuls of castor oil.

Under the weather conditions which now obtain, cream should be despatched to the creamery at least three times a week. It is of the greatest importance that cream should be cooled immediately after separation, and should be kept cool while on the farm and whilst in transit to the railway station or siding. While the cream is being cooled, it should be frequently stirred, using a stirrer with a plunger attachment. Warm, freshly separated cream should not be mixed with old cream which has already been cooled. Cool the fresh cream first and then mix thoroughly with the old cream. Gassiness is a common defect in the cream received at the creameries at this time of the year, and is caused by gas-producing organisms with which the milk and cream are contaminated. These organisms abound in mud, manure, etc., and develop and multiply very rapidly at high temperatures. Any precautions therefore which may be taken to eliminate dirt, manure, etc., from the milk and to keep the cream cool will prevent the development of gassiness.

As the night temperatures are fairly high, cheese-makers should not attempt to use night's milk for cheese-making; morning's milk plus a starter will give the best results. Gouda cheese-making operations are not usually successful at this season of the year, owing to the poor quality of the milk and the prevalence of gassiness. This type of cheese is best manufactured during March and subsequent months.

TOBACCO.

Continue preparation of land. The best results are obtained by transplanting on well prepared soil. Transplanting should be pushed on with as fast as transplants and climatic conditions will allow. As soon as plants begin to grow, go over the field and fill in all missing hills with strong selected plants, and then apply fertiliser to hasten growth and ensure early maturity. Cultivation should be commenced as soon as the plants start growing, especially on sandy soils. The crust caused by heavy rains should be pulverised through cultivation as soon as the surface soil is dry enough for tillage; this gives the young plants the benefit of the moisture stored in the soil. Do not neglect the late sown seed beds. Make every effort to finish transplanting before the end of the month, so that the crop will be harvested before dry, cool weather begins.

VETERINARY.

Occasional cases of horse-sickness may occur during this month. With the great increase in ticks, due to the heat and moisture, cases of redwater and gall-sickness may be expected, more especially amongst Colonial stock imported since the last rainy season. The cool weather which frequently follows the early rains is an excellent time for castrating calves and other animals.

Completion of report by an Inspector in the space provided for "*Remarks* re *pests and other insects found*": "None found. Mr. S. has joined the forces."

But elsewhere the report showed that the premises of Mr. S. were immaculate. Evidently he appreciates the fact that

Cleanliness Aids Insect Control.

Southern Rhodesia Veterinary Report.

SEPTEMBER, 1940.

DISEASES.

African Coast Fever was diagnosed on farm Brakveld in the Salisbury native district.

TUBERCULOSIS.

Four bulls were tested on importation. There were no reactors.

MALLEIN TEST.

Seven horses and ten donkeys were tested, with negative results.

IMPORTATIONS.

From Union of South Africa.—Horses, 4; bulls, 34; cows, 2; sheep, 1,797; pigs, 4.

From Bechuanaland Protectorate.—Slaughter cattle, 1,385; sheep, 231; goats, 50; pigs, 5.

EXPORTATIONS.

To Northern Rhodesia.—Sheep, 42; donkeys, 10.

To Portuguese East Africa.—Slaughter cattle, 120; cows, 7.

To Union of South Africa.—Horses, 2.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

To United Kingdom.—Beef quarters (chilled quality), 7,077; boneless beef quarters, 2,229; pig carcases, 31; tongues, 3,868 lbs.; hearts, 4,712 lbs.; skirts, 2,432 lbs.; shanks, 3,920 lbs.; cheeks, 2,850 lbs.; tongue roots, 4,003 lbs.

To Northern Rhodesia.—Beef carcases, 637; mutton carcases, 60; offal, 53,421 lbs.

To Belgian Congo.—Beef carcases, 76; mutton carcases, 8; pork carcases, 119; offal, 804 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa.—Corned beef, 273,480 lbs.; meat extract, 20,091 lbs.; beef powder, 5,336 lbs.; beef fat, 24,000 lbs.; beef paste, 161 lbs.; tongues, 1,440 lbs.; sausages, 381 lbs.; tin stew, 1,248 lbs.

To Northern Rhodesia.—Meat meal, 2,100 lbs.

To Belgian Congo.—Corned beef, 900 lbs.; sausages, 30 lbs.

B. L. King,
For Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-40.

Monthly Report No. 94. September, 1940.

Red Locust (*Nomadacris septemfasciata*, Serv.).

Swarms of the Red Locust were reported from seven districts during September, namely, Lomagundi, Mazoe, Charter, Hartley, Gwelo, Melsetter and Nyamandhlovu.

Most of the swarms were described as "large" or "very large."

There appear to be more swarms in the Colony than the number of districts involved indicates. Three "large" swarms were reported as visiting one locality in the Charter district in one day, whilst in the Hartley district "heavy swarms" were stated to have passed over one farm all day from 10 a.m. to 3.30 p.m. As usual several large swarms appear to be haunting the eastern border in the Melsetter district.

Some damage to native crops has been reported.

No definite trend of direction is apparent from the information furnished, all points of the compass being included.

Rupert W. Jack,
Chief Entomologist.

THE RHODESIA
Agricultural Journal

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Editorial

Notes and Comments

Members of the Staff
of the Department of Agriculture and Lands
convey to all readers
their Best Wishes for Christmas
and their hopes for
Peace and Prosperity in the New Year

Veterinary Notes.

For the guidance of farmers it is hoped to publish occasional notes from the Veterinary Department on common ailments of animals on the farm and the treatment which should be given to them. The notes will be practical rather than technical. The first of them—"The Care and Treatment of Sick Cattle"—appears in this month's issue.

Chemurgy.

Some of the words which the Americans invent, especially technical words, amuse us at first, but they have a habit of slipping into general use. Perhaps the new branch of science known as "Chemurgy" will one day have a familiar sound in this country. The actual definition of the word is the winning of raw materials of industry from the soil, the air and the sunlight by means of plant life. The national farm chemurgic Council in the United States deals chiefly with the finding of new uses for farm products apart from their use as food, and preventing the waste of unmarketable crops. The use of excess sugar cane for the making of power alcohol is a case in point. A long essay could be, and no doubt has been, written on the use which will eventually be made of agriculture, of the marvellous synthesis of plant life, for the fuel needs of the world. The petroleum resources of the world are finite and the end of them must one day, sooner or later, come. But the carbon dioxide and the oxygen of the air are inexhaustible and the power possessed by plants of building up carbohydrates is eternal.

But this is only one aspect of the case. In America there are over 200 research workers busy on programmes which have received official sanction. The products include practically all the crops grown in this country, and it is one of the objects of the movement to prevent some of the economic loss which results from the tremendous volume of agricultural wastes which find only inferior markets or no markets at all.

Perhaps the making of compost is a variation of "Chemurgy."

Lime for the Land.

On the subject of lime Professor G. W. Robinson writes as follows in the Journal of the Ministry of Agriculture of England:—

In order that the action of lime on the soil may be understood, it may be helpful to give a brief outline of the chemical aspect of the subject. Lime occurs in the soil in three main categories, namely, (1) calcium carbonate; (2) exchangeable lime, *i.e.*, lime combined with the clay and humus of the soil; and (3) lime present in unweathered minerals. The lime of the third category, although ultimately of significance as a reserve supply, is not immediately of use to plants and, for practical purposes, may be ignored. All soils are potentially acid. In a soil containing no calcium carbonate and no exchangeable lime, the clay and humus behave as weak insoluble acids. Such a soil would, of course, be very infertile.

If we were to start with a soil containing no exchangeable or carbonate lime, and add increasing quantities of lime to it, allowing equilibrium to be reached after each addition, we should at first be adding to the exchangeable lime category. Eventually, however, the capacity of the clay and humus to combine lime in exchangeable form would be satisfied and the soil would be termed "base-saturated." Any lime over and above the amount required for base-saturation would remain in the soil as free calcium carbonate.

The presence of free calcium carbonate in the soil is generally an indication that the soil is base-saturated, *i.e.*, that it contains its maximum complement of exchangeable lime. This is not always strictly true. Sometimes the calcium carbonate may be present as comparatively large fragments and the mass of the soil may still be base unsaturated. Also, where lime or limestone have been added to the soil, some time may elapse before equilibrium is attained.

For satisfactory plant growth it is not generally necessary to have excess of calcium carbonate in the soil. *What is needed is a sufficiency of exchangeable lime.* The proportion will vary for different systems of agriculture. For light sandy soils a figure of 0.2 per cent. may be sufficient, while for heavy soils 0.4 or 0.5 per cent. may be necessary.

Agriculture in England.

The effect of war-time conditions at Home may be gauged much better from trade and farming journals such as *The Farmer and Stock Breeder* and *The Fertiliser* than from official communiques and propaganda. The enormous burden which has been placed on British agriculture, the sometimes competing activities of the Ministry of Food and the Ministry of Agriculture and the disorganisation caused by the hazards of war have had an upsetting effect. The

prices which have been fixed by the Ministry of Food for the coming year are thought by many farmers not to give a fair return nor to provide sufficient capital for the extension of ploughing that is envisaged. Two million acres of arable land were ploughed up this year; a further two million at least will be ploughed up next. The farmers of the coastal areas and of the South East Coast particularly, have had added burdens to bear. In addition to indiscriminate Nazi bombing they have to endure shelling from the emplacements of Cap Griz Nez and considerable inconvenience from the Defence Department erecting barbed wire, pill-boxes and fortifications. Labour difficulties have been acute in spite of the Women's Land Army and voluntary helpers, but the summer has been perfect. Pictures of burning ricks and homesteads, shattered sheds and lands pitted with enormous craters show more clearly than words what the farmers, in common with the other citizens of Great Britain, have to endure.

But like the heroic inhabitants of London they will endure anything—uncertainty, disappointment, death and devastation with a strong and unconquerable spirit. They have promised the Minister of Food that however they suffer, they will "Give him the goods." Agriculture is in the front line of defence.

Potash.

An article by Sir E. J. Russell in the Journal of the Ministry of Agriculture on economising potash is a reminder that potash supplies came largely from Germany and from Alsace, which is once more in German hands. Some potash comes from the Dead Sea and some from Spain, but the quantity is insufficient. The United States absorbs almost all of its own large supply.

In Great Britain the consumption of potash fertilisers had increased from 23,400 tons in 1913 to 75,000 tons in 1938. If this increased application represented a real need, then the problem of potash supplies is likely to be a difficult one. The same problem has to be faced in Southern Rhodesia.

Unlike nitrogen, potash is not easily washed out of the soil by rain, except from the lightest soils, and an excess from one season is in part available during the next; but only in part, because much of the potash is converted into an unavailable form. *The soil is a particularly bad storehouse for fertilisers.* For a time, however, the reserves in the soil may suffice to carry on the crop at its old level.

Farmyard manure, particularly the liquid manure, is one of the best means, formerly the only means, of supplying potash; all farmyard manure should be carefully conserved. Compost will also supply a certain amount of potash; wood ashes will supply a fairly high percentage. The use of common salt which as a substitute is efficacious for certain crops in England, is not recommended in this country.

Mixed fertilisers containing potash should be restricted to crops specially needing it.

Prices of Farming Requisites.

The Economic and Statistical Bulletin of Southern Rhodesia of the 7th November, 1940, contains statistics of some interest to the farming community. The compilation of these tables followed a request from the Minister of Agriculture to watch changes in the prices of articles of importance to farmers in different branches of agriculture.

Since 1939 the index shows that the average level of prices paid for farming requisites has increased 19 per cent. The index of prices paid by maize farmers has risen 19.2 per cent., of wheat farmers 20.6 per cent., of tobacco 22 per cent. and of dairy 7 per cent. The small relative increase in dairy prices is due largely to the exclusion of grain bags and fertilisers. In every case there has been a drop in October, as compared with July, for aggregate costs in the different branches of farming.

Compared with August, 1939, grain bags have increased in price by 52, hessian by 59, seed-bed cloth by 40, baling paper by 49, fertilisers by 35, wire by 45 and fuel by 39 per cent. These items account largely for the rise in the index figure.

Star Burweed: Declared a Noxious Weed.

The appearance of a comparatively new weed which is likely to cause considerable trouble in the Colony has recently been placed on the list of noxious weeds in terms of the Act.

The plant is one of the group known as Burweeds, and is characterised by spiny burrs arranged in the form of a star. This particular species has been found growing on a roadside in Salisbury, on the Melsetter commonage, and in the Mondoro Reserve and Norton areas of the Hartley district. Its spread is looked upon with much concern. It is a very aggressive weed and has been reported to have taken possession of areas previously covered with a thick mat of couch grass.

The weed is a very objectionable one and it was therefore considered advisable to take early steps to ensure its complete eradication. If allowed to seed it will be impossible to avoid its general spread over large areas.

The burrs, *i.e.*, the spiny seed cases, stick to the hair or wool of all types of stock, even game and dogs, and are thus spread in all directions. Where patches are discovered that have already set seed, stock should be kept away until the area has been burnt. Immature plants should be destroyed by cutting and pulling to ensure that the plants do not seed.

Star burrweed (*Acanthospermum australe*) illustrated opposite, was first described in this Colony by Brain in Bulletin No. 1038, published by the Department of Agriculture, in July, 1937. Copies may be obtained free of charge on application to the Department.

Wood Ashes.

The recent paragraph in the Journal on the fertiliser value of wood ashes has attracted some attention, but the Conservator of Forests wishes a cautionary word added. In 1936 the Forestry Department carried out an investigation, in conjunction with the Division of Chemistry, on the value of wood ash. The ash was prepared at the Stapleford Forest Reserve under controlled conditions, the wood being very carefully burned. *Acacia mollisina* wood was used, barked

A twig of Star Bur-weed, about natural size

Small twig enlarged to show character of the burs.

and unbarked, freshly felled and dry, and was subjected to quick and slow burning. The resulting ash was in all cases of very high quality, averaging roughly 26% lime, 15% potash and 2.5% phosphoric oxide. But the amount of wood used was out of all proportion to the value of the ash. In all 22,553 lbs. of wood were consumed to supply 86 lbs. of ash.

It would therefore obviously not be worth while to burn wood for fertiliser; but where wood has been burnt for other purposes—as in tobacco barns—and the soil is suitable, wood ash may be a valuable supplementary fertiliser.

How to Distinguish Pullets from Cockerels.

Many poultry farmers who raise chickens of mixed sexes find it difficult to distinguish between pullets and cockerels, particularly amongst the heavy breeds, before they are three or four months of age. This also applies to some of the White Leghorn cockerels which are slow in maturing. There is no difficulty, however, in distinguishing between the sexes when the birds begin to grow their body feathers at about nine to ten weeks of age.

If the feathers on the saddle of the bird are examined it will be noted that there is a distinct difference between those of the pullets and cockerels. In the case of the pullets the feathers are rounded or square at the tip and the whole of the feathers dense, whereas in the cockerels the feathers are narrower and pointed with a fringe along the edges.

Many poultry farmers do not know of this simple means of distinguishing between the sexes, and cockerels are often retained because they are regarded as pullets until they show other definite masculine characteristics.—*The Agricultural Gazette*, New South Wales.

Letters to the Editor

The Editor, *Rhodesia Agricultural Journal.*

Sir,—I recently sent to the Chief Chemist a sample of dry compost, this was found to contain 1.5 per cent. of nitrogen. As it has generally been thought that compost, like kraal manure, looses a large proportion of its nitrogen on exposure and drying, a second sample was taken with great care. This sample was from the outside of the heap which had been exposed from the last turning in April, till October. The second sample also went 1.5 per cent. nitrogen. The compost was made in the ordinary way from material containing perhaps a little over one half of one per cent. of nitrogen. A considerable amount of raw rock phosphate was, however, added together with plenty of wood ash.

Taking the pre-war price of nitrogen in sulphate of ammonia at sixpence per pound, a dressing of compost such as that described would be worth, at the rate of five tons per acre, 75s. in nitrogen alone.—I am, etc.,

J. M. MOUBRAY.

Chipoli, Shamva, October 24th, 1940.

Well, I did as I was requested. And I returned with the impression that the papers I read and the wireless to which I sometimes listen had not conveyed to me, a mere individual, an accurate impression of the morale of the London public. It was wonderful; it was so wonderful that I feel that no effort on our part is too great to help towards the common great cause of victory.—"Blythe," in *The Farmer and Stock-Breeder.*

Veterinary Notes

THE CARE AND TREATMENT OF SICK CATTLE.

By Percy D. Huston, M.R.C.V.S.

Nursing.—Sick cattle should be comfortably housed in a loose box, with an ample supply of bedding. In cold weather it may be necessary to rug them up at night, the rug being removed when the temperature rises in the day time.

If the animal is lying down and is unable to rise, it should be turned over from one side to the other at least four times during the 24 hours.

An animal lying flat on its side should not be allowed to remain in this position, because it quickly becomes hoven; it should be raised to the natural recumbent position, on its breast bone, and if it will not remain so it should be propped up by bedding and if necessary by sacks of hay closely pushed in on the under side.

Feeding.—As one of the first symptoms of illness in cattle is that they cease to feed, it becomes necessary to drench them with good nourishing food to keep up their strength. The most useful foods for this purpose are oatmeal gruel, linseed tea and milk containing beaten-up eggs.

The quantity it is necessary to give depends both on the strength of the animal itself and the probable duration of the illness, but at least 1½ to 2 gallons of nourishing gruel should be given per day. This amount equals 12 whisky bottles, which should be administered four at a time at eight hour intervals.

A supply of clean fresh water should always be available.

Oatmeal Gruel is made by scalding oatmeal with boiling water and stirring well to break up any lumps; it should be made sufficiently liquid to drench out of a bottle.

Linseed Tea is made by boiling one pound of linseed in two gallons of water until the grains are soft.

As linseed tea has a laxative effect, a mixture of equal parts of this and oatmeal gruel makes the most satisfactory drench.

Treacle up to about ½ lb. per day is often mixed with the drench; this as well as being nourishing, also has a good laxative effect and helps to sustain the action of the bowels. In cases where the animal is very weak 4 bottles of milk each containing one egg beaten up may be given three times a day.

If medicine has been prescribed for the animal, it can nearly always be administered with the food that is being drenched.

Drenching.—In drenching an animal the mixture should always be given slowly so as to avoid any risk of the fluid going down the trachea into the lungs and causing pneumonia. The best method is to pour a small quantity into the mouth and remove the bottle, no more being given until what is in the mouth has been swallowed.

If an animal refuses to swallow, rubbing the roof of the mouth with the fingers or a piece of stick generally produces the act of deglutition.

The animal should be frequently tempted to eat by offering it a small quantity of lucerne, green oat forage, green mealie tops or even freshly cut sweet grass, but if it refuses to eat it, the food should be removed and not left to be slobbered over and turned sour, because this invariably stops the animal from eating when fresh food it put before it.

An animal can often be encouraged to eat by putting small quantities of green food in its mouth between the molar teeth.

As a small quantity of food that is taken voluntarily is of much greater value than a larger quantity given in a drench, every effort should be made to entice an animal to eat.

Eating stimulates the act of rumination, which it is often difficult to get started after an animal has been ill for a few days.

Enemas.—In many diseases such as gallsickness, the administration of enemas forms a most necessary part of the treatment, as enemas cause stimulation and evacuation of the bowels.

An enema is made by pouring boiling water on soap and stirring well to get a good soapy solution. To a gallon of soapy water, one pint of linseed oil should be added and well mixed. The quantity used should be about two gallons and should be given at blood heat.

This is best given by a continuous flow pump, *e.g.*, an ordinary spray pump to which is attached about eight feet of tubing, the tubing should be well lubricated with vaseline and before being passed into the rectum all faeces should be removed as far forward as the arm can reach. The tube should be passed in slowly with a forward and backward movement and no force should be used against resistance; pumping a little fluid in during the passing of the tube dilates the bowel and renders the passage of the tube more easy.

At least two feet of tubing should be passed so as to encourage the fluid to flow forwards. To be of any service an enema must be retained for at least fifteen minutes, and if this is not done another should be given after an interval of two hours.

It should be realised that in many cases the recovery of a sick animal depends nearly as much on good nursing as on the medicines that are given to it and a great deal more attention should be paid to the nursing of animals than is usually the case.

Field Spraying of Tobacco

REPORTS FROM DEMONSTRATION PLOTS.

By J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A.,
Senior Plant Pathologist, Department of Agriculture.

Spraying of tobacco in the field for the control of spot diseases is a comparatively recent innovation in Southern Rhodesia. Although it has been known for many years that disease epidemics could be checked successfully on experimental plots, the value of this operation on a farm scale was not tested out fully until a few years ago. A few growers have, however, sprayed their crops for some years past. In the seasons 1936-37-38 and 39 close observations were kept on several crops which were sprayed with copper fungicides; successful control of wildfire, angular spot, frog-eye and, to some extent, *Alternaria* being accomplished. The area treated varied from about 20 to 80 acres. The economics of the method were investigated and there is no doubt that the cost of spraying was handsomely repaid by the results obtained. It was, therefore, decided to organise demonstration plots throughout the different tobacco growing areas and last year arrangements were made for 10 plots of 10 acres each to be sprayed under the direction of this department. Manufacturing firms kindly supplied fungicides, the Department loaned pumps, whilst the farmer provided the labour and supervision.

Reports on these demonstration plots have been received from the various growers who kindly undertook the work, and it seems desirable that their experiences should be passed on to tobacco growers as a whole.

Instructions were issued for the following procedure:—

Plants were left untouched for three weeks after setting out in the lands in order to avoid the spread of mosaic from those in which the appearance of symptoms was delayed. The plots were then sprayed by means of knapsack pumps with copper fungicides such as Bordeaux Mixture, Bouisol or Perenox. In advance of the spraying gang were boys who carried out the first priming, particular attention being paid to the removal of every leaf showing spot diseases. These leaves were carried from the land in sacks and buried under several inches of soil. At four and five weeks the same procedure was adopted and after that the crop was allowed to grow without further spraying. Where necessary, another priming was carried out in order to improve the quality of the top leaves, whilst at the same time eliminating the possibility of late development of frog eye. The results of these demonstrations may be summarised in extracts from the reports received.

The first farmer, who grows about 600 acres, says:—

"It is very difficult to come to any definite conclusion when only taking one season into consideration.

"The sprayed plot was definitely cleaner than the control plot. It was very noticeable when there was an average of four leaves left to a plant. The control plot we had to reap on the green side, but the sprayed one we were able to leave for another week, giving time for the leaf to ripen.

"I would very much like to do another test for you this season. I hope to spray at least two-thirds of the crop."

Another reports:—

"Results of spraying 10 acre plot were somewhat disappointing. The surrounding field became badly infected with angular and *Alternaria*, which eventually spread into the sprayed plot. Even so, the sprayed plot was obviously more free, and a fair crop of commercial leaf was reaped from it.

"I have purchased a stock of fungicide sufficient to spray 50 acres this year."

A report on third year land is as follows:—

"The plants . . . were regularly sprayed with Bordeaux and arsenate of lead weekly, from 3 weeks old in seed-beds, to planting out 7 weeks from seeding.

"About 3 weeks to 3½ weeks after planting, and after the first two hand cultivations, field spraying was started with . . . a gang of 6 natives . . . and 3 youths priming off all lower leaves and spotted leaf up to 8 inches from the ground. This land at this time was showing distinct signs of angular spot when spraying started. . . . A week later the second spraying was commenced. . . .

"After this second spraying the growth was very rapid and before the third spraying could be carried out many plants were showing buds. There was a particularly dry spell on at the time, and it was considered too risky to continue the spraying, in case the leaf ripened off, the fungicide still coating the leaf, and thereby depreciating its value.

"We reaped over 570 lbs. of leaf per acré from this sprayed land, but consider that we should have got over 700 lbs. had we not discarded such a large amount through *Alternaria*. Although we got this infection of *Alternaria* late in the reaping of this land, we consider that spraying as we did helped considerably to delay infection. We have experienced the complete loss of as much as 50 acres through this disease taking hold on third year lands.

"On one part of the field which only got one spraying, the *Alternaria* was very much more severe, so that we feel we can fairly safely say that the spraying undoubtedly had a checking effect on it, when done twice. . . ."

A grower at Norton also seems satisfied:—

"My impression is that the spraying was definitely beneficial in checking angular and *Alternaria* spot. As you may remember, my plot had a very bad start and angular spot was visible in the early stages of growth, but this seemed to disappear before curing started. I never saw *Alternaria* in the plot, although other fields on the farm had slight infection. . . ."

The only unfavourable report was summarised in its last sentence:—

". . . I should say the results of field spraying last season were negative, but I shall continue with it this coming season."

And finally, from a district where *Alternaria* does much damage, comes the following report:—

"The spraying would appear to have been beneficial, as the small unsprayed section I left as a control finished up with very few leaves per plant, owing to so many diseased leaves having been primed off. I lost a lot of tobacco from *Alternaria*, but very little in the sprayed field.

"I am prepared to do another spraying test this season."

Of the remaining four plots two verbal reports were received. The first was to the effect that though angular spot and frog eye were at one time widely distributed, the diseases were reduced by spraying, which was also assisted by a spell of dry weather and it is uncertain how much benefit was derived from the spraying. Eventually an almost clean crop was reaped.

The second grower stated that he intended to confine the spraying to 10 acres, but he eventually decided to spray his whole crop, with the result that he reaped the highest yield and the cleanest tobacco that he had so far grown.

No results were obtained from the remaining two plots owing to the illness of the farmer in one case, and the poor growth of plants on old land in the second case.

With regard to costs, it has been shown that only 10 to 15 gallons per acre per spraying of fungicide (depending on the size of the plants) are required to effect control of angular spot, wildfire and *Alternaria*. Thus for spraying 10 acres three times, the total consumption should lie between 300 and 450 gallons. The cost of materials depends upon the brand of fungicides used and varies from 18s. 7½d. to £3 6s. 1d. for the quantities stated. The total cost for 100 acres, not including seed-beds, would therefore be from £9 6s. 3d. to £33 0s. 10d. per season, *i.e.*, ten times that required for 10 acres.

The demonstrations are being repeated this season on nine farms in the following districts: Umvukwes, Concession, Eldorado, Trelawney, Salisbury South, Arcturus, Rusapi, Glendale and Norton.

Interested growers are referred to the section on *Field Spraying* in Supplement I, page 13, of "Diseases of Tobacco in Southern Rhodesia," issued by the Department of Agriculture, price 1s.

Piggeries

By B. G. Gundry, A.I.Mech.E. and A. E. Romyn, Ph.D.

In the following pages it is proposed to describe the construction of a simple type of permanent central piggery, and also temporary and portable houses for use in paddocks where pigs are run on the colony system.

The general type and design of the buildings and accessories described are based on the recommendations of the division of Animal Husbandry.

Site.—In selecting a site for a permanent piggery such as is shown in Plate 1, preference should be given to a piece of well-drained ground having an even fall of about 1 in 80 to facilitate drainage.

If possible, the site should be to the leeward of the main homestead, within easy reach of the dairy and feed grinding floor, if such are in existence.

Coolness is an essential factor to be considered, and the piggery should not therefore be shut in by other buildings or dense trees. While a certain amount of shade is desirable, sunlight should not be entirely excluded, particularly in the early morning hours. It is an advantage to have the piggery in close proximity to some permanent pasture with a few shady trees, in which the pigs can be turned out to graze. A suitable spruit of running water, in which they can wallow in hot weather, is also an asset, but, of course, the pigs must not be allowed to pollute a neighbour's water supply.

Foundations.—Having selected the site and decided on the number and arrangement of the pens to be built, the foundation trenches may be pegged out. In order to get the angles square, it is advisable to set them off with a wooden triangle made from floor or ceiling boards, with sides of 6 ft., 8 ft. and 10 ft. respectively. If accurately made, the angle opposite the longest side will be a right angle.

On a good compact formation, the trenches should be dug 12 ins. deep, but as the ground surface is, or should be, sloping, and the bottom of the trench must be kept level, it will be necessary to step them down by the thickness of one brick at the necessary intervals to keep the trenches at the proper depth throughout. It will be convenient to make these steps to correspond with a division wall in the pens, as will be seen in the side elevation of the piggery illustrated in Plate 1.

The width of the trenches should be 6 to 9 ins. wider than the maximum width of the foundation. The bottom of the trenches should be quite level, and when finished should be tamped evenly all over to thoroughly consolidate the sub-soil.

The foundations themselves may be built of hard, well-burnt bricks, stone or concrete.

The lower courses should be at least 50 per cent. wider than the thickness of the walls they are to support, except for the feed room or other building, the walls of which are to be more than 6 or 7 ft. in height, where they should be twice as wide as the thickness of the walls.

The foundations, which comprise all the work below the damp course, whether of brick or stone, should preferably be laid in 1 to 5 cement mortar. A cheaper alternative is to use a lime mortar mixed in the proportion of about 1 part lime to 6 parts of sand. The durability of this mortar can be considerably increased by the addition of 10 per cent. of cement, which should be added to small batches of the mortar immediately before it is used. Under no circumstances is the use of dagga recommended for laying foundations.

If, in exceptional circumstances, it is decided to use concrete for the foundations, the trenches should be neatly excavated to the exact width the foundations are to be. The concrete, mixed in the proportion of 1 part cement 3 parts sand and 6 parts stone, is then placed in a layer about 4 ins. thick and tamped down. The foundations can then be completed to the damp course level in brick or masonry as described above, or, if they are to be completed in concrete, shuttering must be arranged in which to mould the concrete to the height and thickness desired.

Damp Course.—A layer of material impervious to moisture and "white ants" must be placed on the completed foundations. A bitumastic fabric known as damp course felt, or 26-gauge galvanised iron, are the materials most commonly used for this purpose. A layer of cement mortar only is not considered satisfactory, as it is liable to crack and is not entirely damp-proof. There is little difference in the cost of iron and felt—the latter is more easily cut and handled, but the former is probably the more durable. If iron is used, it must be cut into strips the same width or a little wider than the top of the foundation. The strips are joined end to end either by overlapping them by about 3 ins. and soldering them together over the full width, or by hooking the ends together and hammering them flat, care being taken not to damage the galvanising.

If lime mortar has been used in the foundations, the top course of brick or stone should be covered with a thin layer of 1—5 cement mortar before an iron damp course is placed in position, as lime reacts on the galvanising and eventually destroys it. For the same reason cement mortar should be used for laying the course immediately above the iron. No such precaution need be taken if felt is used. This material is cut into strips of the necessary width and any convenient length, and where these join they should overlap by at least 6 ins. It will be seen from the drawings that the level of the damp course is approximately 6 ins. above the adjacent ground level at the back of the pens, and is stepped down one course at the walls dividing the pens from the yards.

The surface of the floors should be level with, or rather below, the damp course.

Walls.—The walls may be of brick or masonry. The former should be all 9 ins. thick, but the latter will require to be somewhat thicker, those on the outside being from 15 to 18 ins. thick and the division walls from 12 to 15 ins., according to the size and shape of the stones available.

The type of bond known as "squared rubble" is recommended in preference to "random rubble," which, when attempted by the ordinary native builder, is apt to degenerate into a mere untidy pile of stones possessing neither strength nor durability.

It will be noted that a fair proportion of the stones should occupy the full width of the wall, like the "headers" in a brick wall. Only hard, sound stones should be used, and they should be laid on their natural beds, *i.e.*, with the grain or laminations, if such are visible, lying horizontal.

Lime mortar mixed in the proportions of 1 part lime to about 6 parts of sand is recommended for laying either bricks or stones, but on account of its cheapness, dagga is likely to be more popular. It must be remembered, however, that while dagga is quite satisfactory if kept dry, it becomes useless if moisture is permitted to penetrate into the wall. A large proportion of the walls in a piggery have no roof to protect them, and it is therefore necessary to take particular care to render them perfectly weather proof. The surest method of doing this, particularly with brick walls, is to plaster them with 1 to 4 cement plaster, to which a half part of well slaked lime may be added to make it work more easily and to render it somewhat more waterproof.

The top of the exposed walls should be rounded as shown in the cross-section of a wall on Plate 1.

The brickwork should be kept slightly damp as the plastering proceeds, so that the plaster is not dried out too quickly and spoilt.

Masonry walls built of comparatively small stones should also be plastered, the dagga joints being first raked out to a depth of about an inch in order to give a key for the plaster.

Walls built of large, well-shaped stones are better left unplastered, but the joints must be raked out to a depth of 1 in. and pointed with a 1 to 3 cement mortar, great care being taken that no small holes are left into which rain can penetrate. The tops of such walls should be plastered and rounded off with the same mixture.

Floors.—The floors should be of either stone or concrete. Cement-plastered brick floors are not recommended owing to their liability to crack and their inability to withstand the wear and tear to which they are subjected.

If flat slabs of hard stone are available, they make an excellent and cheap floor, but they must be very evenly laid so that rain water and urine cannot collect in puddles. Before any stones are laid, the original ground surface must be brought to the proper height and slope and tamped solid.

Each stone must be carefully bedded down on a layer of sand about 1 in. thick by a few blows with a heavy piece of timber. A row of stones should first be laid down each side of the pen or run, particular care being taken, with the aid of a straight edge, to see that they are evenly laid to the correct slope. These two rows can then be used as a guide for the straight edge, which, when resting with one end on each row, can be used to test the intermediate stones as they are laid. Particular care must be taken to avoid any depressions in the corners or sides of the pens or yards, and to avoid this it is as well to allow the floor to slope very slightly from the sides towards a small depression about half an inch deep running from the entrance to the pen to the hinge side of the gate in the yard, but the formation of an actual gutter should be avoided.

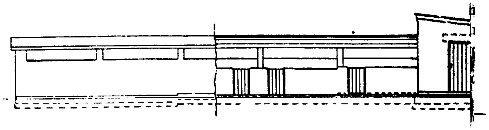
A space of about half an inch should be left between adjacent stones, which, when the floor is otherwise finished, is filled in with a grouting mixture of 1 part cement to 3 parts sand. This should be fairly liquid, so that it can be thoroughly worked in to all the joints with the point of a trowel, the object being to prevent water soaking through the floor.

There should be a step about 1 in. deep between the pen and the yard to ensure that during a heavy downpour of rain, water cannot flow back from the yard into the pen.

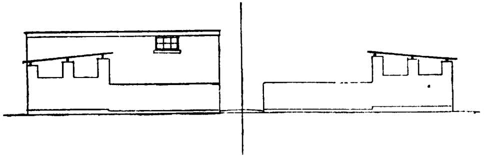
Before a concrete floor is laid, the ground surface should be prepared as previously described, but if possible a layer of gravel or hard broken bricks a few inches thick should be laid down first and tamped solid.

As no delay must take place when the concrete is being placed, use must be made of level pegs. These pegs, which should be about 1 in. diameter, are driven into the ground in straight lines about 3 feet apart each way, so that the top of each peg is exactly at the height which the surface of the floor is to be at that particular spot. Their height should be carefully checked and adjusted with a straight edge so

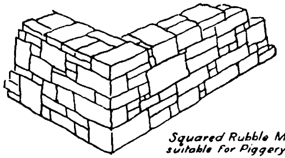
PLATE 1.



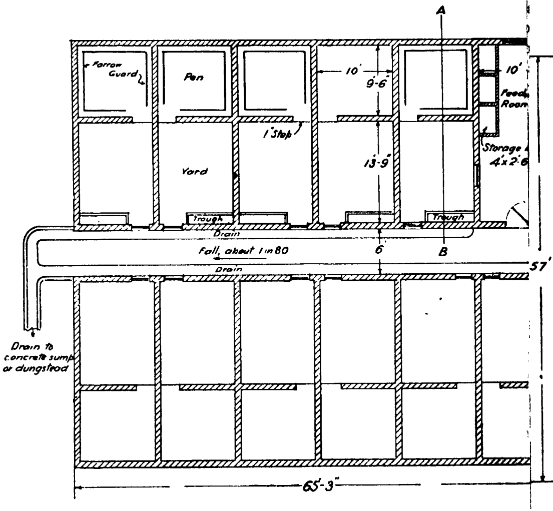
SIDE ELEVATION, (Part section)



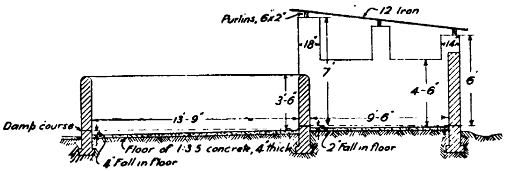
END ELEVATION



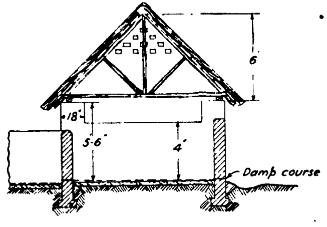
Squared Rubble Masonry suitable for Piggery buildin



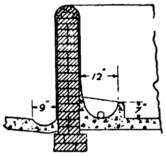
PLAN



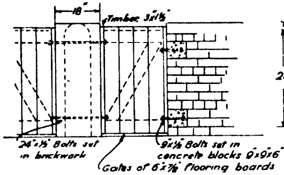
Section on A-B



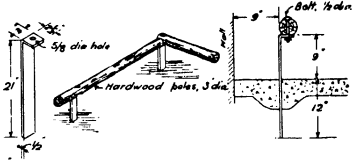
Section thro' Pen with thatched roof.



Section thro' end wall showing drain & trough


18"
Timber 3"x1½"
24"x½" Bolts set in brickwork
9"x½" Bolts set in concrete blocks 9"x9"x6"
Gates of 6"x⅞" flooring boards

Method of securing gate posts to wall



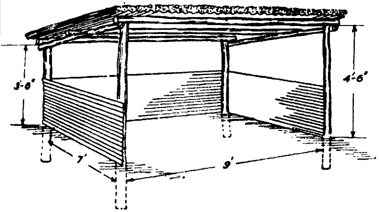
Farrow Guard & method of setting iron supports in concrete floor.

DESIGN FOR PIGGERY

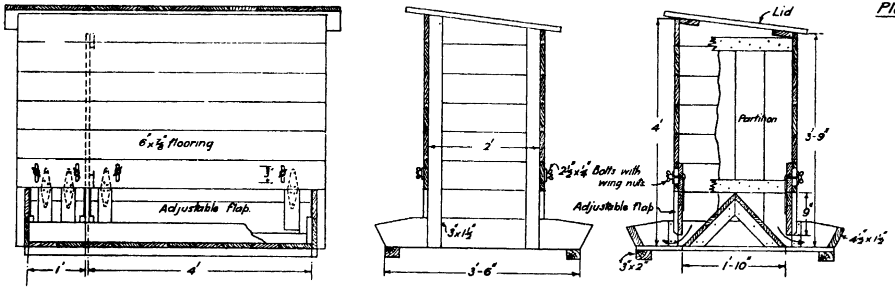
Central Housing System

Irrigation Division
BEE 9/6/32

Plate 2



TEMPORARY COLONY HOUSE

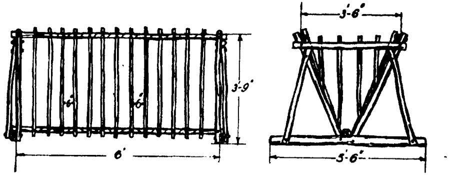


Side View.

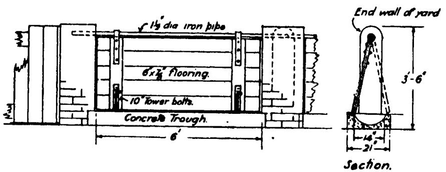
End View

Section

AUTOMATIC FEEDER.

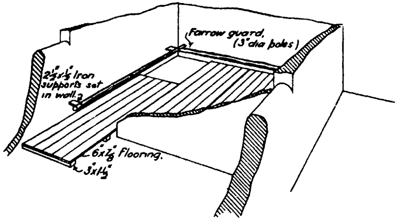


HAY RACK.

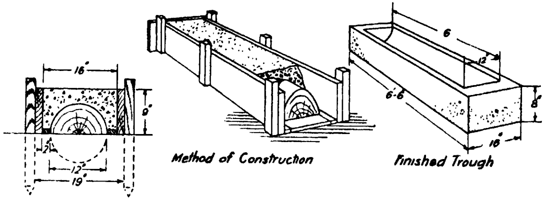


Section.

FEEDING TROUGH WITH SWING DOOR


Farrow guard, (3" dia poles)
2½"x½" Iron supports set in wall
6"x7/8" Flooring.
3"x1½"

WOOD FLOOR FOR PERMANENT HOUSE.

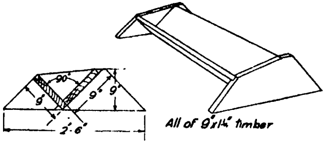


Section

Method of Construction

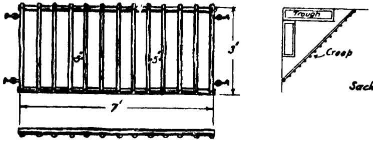
Finished Trough

CONCRETE TROUGH

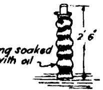


Section

WOODEN TROUGH.



PIG CREEP.



RUBBING POST.

Irrigation Division

that the floor will be at the correct grade. The same care should be taken to make a slight depression to localise the drainage, as explained in the case of stone floors.

The concrete should be of the proportions of 1 part cement, 3 parts sand and 5 parts aggregate, *i.e.*, broken stone. In order to obtain a hard wearing surface, it is best to finish the concrete with a sufficiently even surface so that plastering or "topping" is unnecessary. In order to do this, particular care must be taken to obtain a well-graded aggregate. This should consist of sound, hard stone such as granite or quartz broken into various sizes, from those which will just pass through a three-quarter inch diameter ring down to a coarse sand, the proportionate number of the different sizes being such that they pack together to form a dense mass. All oxidised or friable stone should be discarded.

The ingredients of the concrete must be mixed thoroughly before and after the water is added. It must be remembered that the setting of cement is a chemical reaction which commences about 30 minutes after the water is added, and each batch should be mixed, placed and finished off within that time, if the full strength of the concrete is to be obtained. The concrete must be placed as evenly as possible and rammed down level with the tops of the pegs with a rammer having a face about 6 to 8 ins. square, covered with metal. If it is found that in places the sand and cement do not work up sufficiently round the aggregate to form a fairly smooth surface, a small quantity of mortar consisting of 1 part cement to 3 parts of coarse sand may be placed on the bad patches and tamped in.

This same mixture may be used for filling in the holes left by the level pegs, which are removed as soon as the concrete immediately surrounding them is completed. To facilitate their removal they should be slightly tapered.

The concrete trough may, if the builder is sufficiently skilful, be roughly moulded integral with the floor and finished off with a 1—3 cement plaster as soon as possible afterwards; otherwise, the space occupied by the trough should be left bare and the trough moulded as a separate operation.

Immediately the concrete is finished, it must be covered with clean grass or old sacks and kept damp as described later in some general remarks on the use of cement.

The feed passage and drains may be constructed either of stone or concrete in the same method as described for the floors.

Roofing.—Corrugated iron or thatch, or a combination of these two materials, may be used for roofing the pens.

Corrugated iron alone has the disadvantage of making the pens rather hot during sunny weather, but in order to overcome this objection, it may be covered with a layer of thatching grass about 3 ins. thick. The iron is supported on three purlines, resting on pillars prejecting from the walls dividing the pens, and to which they are anchored by strips of hoop-iron built into the top six courses of brickwork. The purlines may be of 6 in. x 2 in. imported timber, as shown in the drawing, or straight gum-poles having an average diameter of about 4 ins. may be used. In order to give the roof a neat and workmanlike appearance, the upper surface of the poles should be dressed off perfectly level with an adze.

If the iron is to be covered with grass, short lengths of 14-gauge galvanised iron wire should be twisted round the roofing screws before they are driven right home, so that the two ends of the wire, about 6 ins. long, are left with which to tie down the laths or wires which will have to be laid over the grass to keep it in position.

If a thatched roof is to be erected, it should be carried on triangular principles as shown in the drawing; these rest at intervals of three to four feet on bearers running along the front and back of the pens. The purlines may consist of thin straight sticks of native timber or 10-gauge fencing wire spaced 12 ins. apart.

The roof of the feed room, if of iron, is carried by 4½ in. x 1½ in. rafters placed 5 ft. apart, crossed by three lines of 3 in. x 2 in. purlines. A thatched roof would be built similarly to that shown for the pens.

Gates.—The gates for the runs may be made from 6 in. x ⅞ in. flooring, or boards from a heavy packing case. They should be not less than 2 ft. wide by 3 ft. 6 in. high. The battens and diagonal brace should be screwed and not nailed to the uprights. They are hinged by two 18 in. Tee hinges to gate posts of 1½ in. x 3 in. timber bolted to the walls. The posts on either side of the division walls, on which the gates are hung, may be conveniently fixed by means of half-inch bolts screwed at both ends, set in the intervening brickwork as shown in the drawing. The opposite posts are best secured by bolts set in small concrete blocks built into the walls. These blocks can be cast in a wooden box, the inside dimensions of which are 9 ins. x 9 ins., and equal in thickness to two bricks, plus the thickness of one mortar joint, which will amount to about 6½ ins. in all. As the concrete is filled in, an ordinary hexagon-headed bolt 9 ins. x ½ in. is set in position so that it projects 2⅛ ins. from the end. The concrete for this purpose should be of 1 part cement, 2 parts sand and 3 parts small stones. When quite set, the blocks are removed from the moulds and built into the wall. As a number of such blocks will be required, a multiple mould should be made with two 9 in. planks standing on edge on a level piece of ground, with division pieces set cross-ways, making a number of compartments of the required width.

An alternate type of gate may be made with the battens projecting about 1 in. on either side so that they slide up and down either in a groove cut in the gate posts, or between two strips of wood about 1 in. square nailed to each side of the post so that a slot 1 in. wide is left between them.

A piece is cut out of these strips about 6 ins. from their lower end, so that when the gate is raised about 6 ins. and the top batten is clear of the posts the lower batten is opposite this gap and the gate can be entirely freed without lifting it any further. It is secured when shut by an ordinary bolt or a pin, such as a stout nail passed through the end of one of the battens and the post.

This type of gate is not so convenient as the hinged variety, but the cost of the hinges is saved, and they are very secure.

Farrow Guards.—Farrow guards are necessary in the breeding pens to prevent the sow from crushing the young pigs against the walls. The guards may consist of straight hardwood poles about 3 ins. diameter, bolted to iron supports set in the floor. These supports may be made from old wagon tyres drilled and bent over at the top as shown in the drawing.

If the floors are of stone, it is advisable to leave spaces about 16 ins. square where the supports are to be placed, and when the floor is finished the supports are put in position and secured by filling in the space around them with concrete. If the floors are to be of concrete, the supports are placed in position first by driving them into the ground so that their tops will be at the correct height above the floor. It is advisable to excavate a depression two or three inches deep immediately round the iron so that the concrete is thicker there and holds the supports more securely.

Feed Room.—A suitable building in close proximity to the piggery in which to store and mix the foodstuff is a great convenience.

The floor may be of concrete, or, for cheapness, may consist of bricks laid flat and plastered with 1-4 cement plaster three-quarters of an inch thick. The walls also should be plastered with the same mixture to make the building as vermin proof as possible. A few bins about 4 ft. long by 2 ft. 6 ins. wide and 2 ft. high for the storage of foodstuff are also a convenience. They can be built of brickwork 4½ ins. thick laid and plastered with 1-4 cement mortar. They should have well-fitting lids of wood or galvanised iron to exclude rats, etc.

Before passing on to the colony system of pig keeping, there are two modifications to the building already described which are well worthy of attention.

The first is the introduction of wooden floors in the breeding pens, such floors add considerably to the comfort and health of the sow and young pigs, particularly in cold localities. It also minimises losses at farrowing due to the young pigs getting entangled in deep bedding and being overlain by the sow. As it is essential that the floors should be removable for cleaning purposes, they have to be made in four sections, each section is 2 feet 6 inches wide by 9 feet 6 inches long. If the opening to the pen is made 2 feet 9 inches wide, each section can be slid in under the farrow guard as illustrated on plate 2. It will be noted that where wooden floors are to be installed, the farrow guard must be supported by brackets built into the wall instead of in the floor, and they must also be set 12 inches instead of 9 inches above the concrete floor, so that they are the correct height above the wooden floor when in position.

Lengths of old tyre iron about 4 inches wide and 30 inches long, drilled for a half-inch diameter bolt, 1½ inches from each end will make satisfactory supports. These should be cast in concrete blocks 12 inches long by 9 inches wide by 6½ inches thick, which are built into the wall so that the iron projects by an equal amount on either side of the division walls, and will support the guards in the adjacent pens. The support in the wall between the pen and the yard will need to be only 18½ inches long, as it has to project on the inside only.

The floors themselves are made from ordinary 6 inch flooring supported on four 3 x 2 inch battens to which they are nailed with 4 inch nails, clinched or bent over on the under side.

The second item is a labour-saving device in the form of a special trough set in the front wall of the yard over which hangs a swinging door or shutter. By this arrangement the trough may be filled from the feeding passage without entering the yard, and the pigs are prevented from getting into the trough while the food is being poured in and thus saving waste. At the specified feeding times the doors are swung to the open position to permit the pigs to feed. In some instances where this type of trough is fitted, the gate into the yard is entirely dispensed with, the door of the trough being fully opened to give ingress and exit for the pigs while humans merely stride over the top. This arrangement, although perhaps a little crude, permits one to instal the improved type of trough at very little greater expense.

The illustration on plate 2 shows the method of construction; the pipe from which the door is hung must, of course, be securely fixed at the ends, and this is best done by setting it in concrete blocks, although there are many alternative ways of hanging this door. One cheap method particularly adaptable when the ordinary gates are dispensed with, is to lay a stout piece of timber such as a gum-pole 4 or 5 inches in diameter on the top of the wall to which it must be secured with hoop iron straps, and hinge the door with rings to eye bolts passing through this timber. A more permanent method is to cast a reinforced concrete lintel over the opening and set the eye bolts into that.

Piggery with Dunging Passage.—A piggery with a dunging passage is shown in figure 3.

A dunging passage is an additional feature to the standard plan shown in Plate 1, which many farmers have added recently when erecting new pig sties. The pigs soon learn to leave practically all their droppings in the passage and so keep the main sties clean.

The advantages of concentrating the droppings in this way are twofold:—

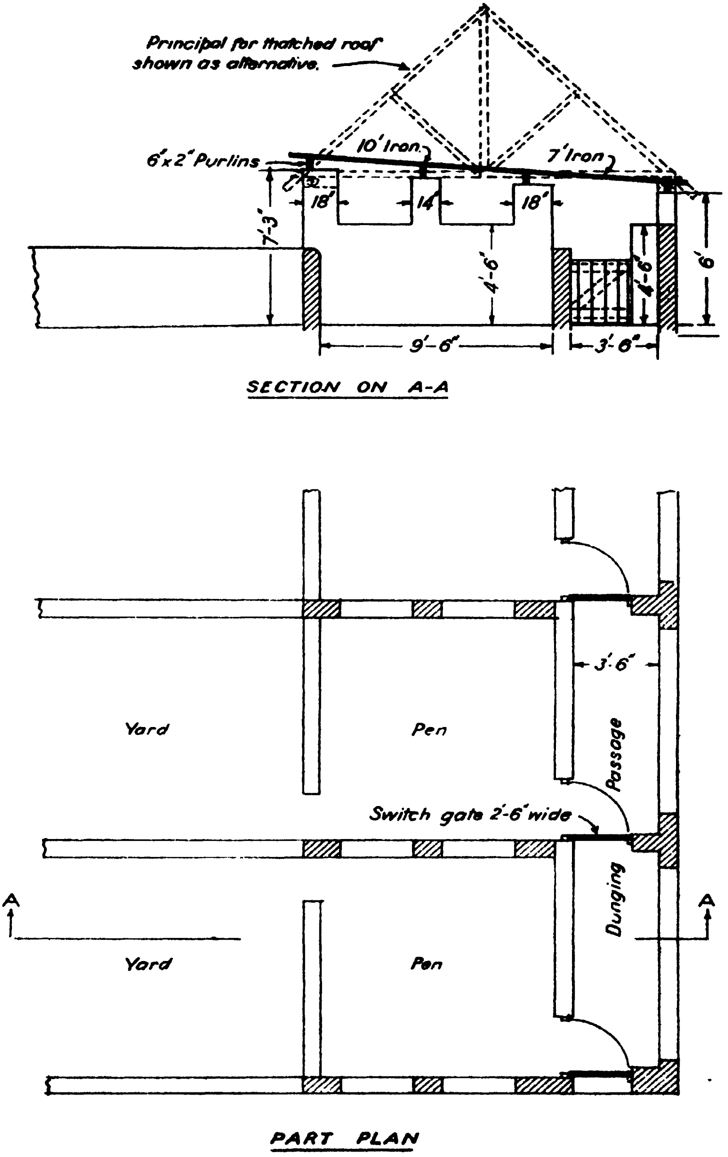
(1) It is much easier to keep the sties clean.

(2) Control of internal parasites is simplified, as most of the infection, which is through the faeces, is concentrated in a small area which can be kept clean without unduly disturbing the pigs and where the young pigs do not usually feed.

In the plan shown the roof is extended to cover the dunging passage. This type of roof is recommended as it assists materially in keeping the sty cool if the right facing is given to it. This feature is not essential, however, and many farmers merely build the passage as an addition to the standard piggery and it answers quite effectively.

When the swing shutter type of trough (as shown in Plate 2) is used for the main sty, it is not necessary to provide a gate in the yard as well as one in the dunging passage.

Colony Houses.—In countries where building timber is relatively cheap, pigs are frequently housed in wooden sheds built on runners so that they can be hauled from camp to camp, but such buildings would be too costly in this Colony, and as an alternative it is recommended that a type of temporary house such as that illustrated on plate 2 should be used.



PIGGERY

WITH

DUNGING PASSAGE

For other details see plate I

Fig. 3.

Such a house consists of four upright poles carrying a roof of corrugated iron covered with thatch, or of thatch alone. The sides may be of single sheets of corrugated iron or of pig-netting or wooden rails covered with thatching grass, tied on with "tambo" or baling wire.

If the roof is made as a separate unit and bolted to the uprights, it can be readily transported to a new set of uprights on a new site each season, or if the butts of the uprights are tarred they can be dug up and transferred from one site to another, and such houses in which iron is used may be regarded, at least, as semi-portable; those of thatch only would be better burnt when finished with.

Automatic Feeder.—Various types of automatic feeding hoppers are popular among pig farmers in America where they are strongly advocated by the various agricultural authorities.

Many advantages are claimed for this method of feeding. In the first place, it saves labour, as several days' supply of food can be placed in the hopper of a feeder and is available as and when required. An economy in food is effected, as it cannot be easily scattered. The pigs being "food wise" select the food they require and to a large extent balance their rations, with the result that the pigs put on weight quicker than when fed by hand for a smaller consumption of food per pound of increase in weight.

This method of feeding is particularly advantageous for young pigs and porkers which require food in small quantities at frequent intervals; it is, however, likely to be over-fattening for baconers. There is no danger of pigs over-eating themselves.

There are many designs of these feeders, and one of the simpler type is illustrated on plate 2. As will be seen, it consists of a hopper 5 feet long and 2 feet wide, divided into two compartments 1 foot and 4 feet long respectively; the former is for meat and blood meal, etc., and the latter for maize or other grain.

The flow of feed from the bottom of the hoppers into the troughs on either side is controlled by adjustable hinged flaps by which the opening through which the food escapes may be varied in width to suit the particular type of food.

As will be seen in the drawing, the flaps themselves, which are 9 inches wide and run the full length of the compartments, are hung by 4 inch strap hinges to 6 inch boards, the position of which is adjustable by means of round headed bolts fitted with washers and wing nuts passing through vertical slots in the lowest fixed boards in the sides of the hopper. The position and length of the slots should be such that the opening between the bottom of the flaps and the trough through which the food passes, may be entirely closed or opened to a width of 2 inches.

The correct adjustment of the openings is all-important if the full benefit of this type of feeder is to be obtained. The flaps should be set so that the action of the pigs nosing at the opening and pushing against the flaps will cause the food to trickle through at the proper speed. The pigs should have to work for their feed, but must not be discouraged by too great a difficulty in obtaining it. The object of having the flaps hinged is to permit them to move inwards and thus agitate the food and prevent it sticking in the opening.

Hay Rack.—A hay rack constructed of native timber as is shown in plate 2 is useful, where breeding pigs are kept in paddocks or pens, for feeding lucerne and other palatable leguminous hay. By the use of such racks the hay is kept dry and clean and the pigs are encouraged to eat such hay, with, as a rule, beneficial results on the size of the litters. The main frame work is best bolted together with three-eighth inch diameter bolts, and the thinner sticks forming the sides can be either nailed in place or bound on with fencing wire.

Troughs.—Two types of portable troughs are illustrated. The first is of concrete and may be constructed in the following manner:—A log of wood about 6 feet long and 12 inches in diameter, as straight and circular as possible, is embedded in a piece of level ground up to its longitudinal axis. The ends are bevelled off to a good slope so that it will eventually draw away from the concrete cast round it without difficulty. Two strips of board 2 inches wide and 1 inch thick are now laid on the ground on either side of the log and are trimmed up where necessary so that the inner edges fit neatly against the log along its whole length. The strips should extend 3 inches beyond each end of the log, and the spaces between the projecting ends are filled in with other pieces of board. Two lengths of 9 inch by 1½ inch plank, planed smooth on the inner side, the same length as the strips, are now placed upright on either side and are held in position by three pegs about 2 inches square, driven well into the ground. If the soil is not sufficiently hard to hold them rigid, strips of wood (not shown in the drawing) may be nailed across each pair of pegs to tie them together and prevent them being forced apart when the concrete is rammed into the mould. In any case these ties would be an advantage, as it is desirable that the mould should be as rigid as possible. Two end pieces of 9 inch by 1½ inch plank are now screwed to the end uprights, to which the side planks should also have been nailed or screwed and the mould is complete.

Any cracks in the log or planks and any crevices between them should be filled in with clay or wax, and the whole interior surface with which the concrete will come in contact should be rubbed over with thick oil or grease to prevent the concrete sticking, but it must not be left as a thick layer which will mix with, and spoil the concrete.

Actually, all that is now necessary is to fill the mould with concrete, but the writer would suggest that before doing so the inside of the mould should be roughly plastered over with a thin layer of 1:2 cement plaster in order to give the inside of the finished trough a hard smooth surface.

This must be done as the concrete is being mixed, as the plaster must not be allowed to commence to set before the concrete is added. The whole operation of plastering and filling should be completed within half an hour from the time water is first added to the plaster and concrete. The concrete should be mixed in the proportion of one part cement, two-and-a-half parts sand and four parts stone, which must be crushed to pass a ¾ inch ring. About one pocket of cement will be required for the job.

When filled, the mould must be covered with wet sacks and kept continuously damp for at least 72 hours before any attempt is made to remove the trough from the mould. After removal the trough must be immediately re-covered and kept damp continuausly for a further four or five days—longer if possible.

A mould of this description can, with reasonable care, be used over and over again, but the timber should not be left exposed to the sun as it will warp and twist; in fact, it is a great advantage to carry out any concrete work of this nature in an entirely shaded spot.

A light wooden trough can be fairly easily constructed from 9 inch by 1½ inch planks. Two end pieces are cut to the shape shown in the illustration, which are designed to prevent the trough being readily overturned. The sides of the trough are let into the end pieces to a depth of half an inch. This can be done by making two pairs of saw cuts 1⅜ inches apart and half an inch deep, roughly at right angles to each other and cutting out the intervening timber with a chisel, thus forming two grooves into which the ends of the side planks are fitted. Three screws 4 inches long can then be driven in through the end piece into each side piece. If a strip of stout hoop iron is nailed right round the edge of each end piece and other strips are used to tie the sides to the end pieces, the durability of the trough will be considerably increased.

Such a trough can be made to any convenient length up to 6 or 7 feet. A plank 16 feet long, costing about 8s., will make a 6 foot trough.

Pig Creep.—This is merely a grating made of straight veld poles nailed or screwed together, which can be placed across the corner of a pen, and behind which small troughs may be placed to which the young pigs will have access but from which the sow will be excluded. This is a big advantage in forcing the growth of the young pigs, and when necessary special rations can be fed to them only. The creep can be held in position by screw hooks engaging with eyes screwed into wooden plugs driven into the walls of the pen.

Rubbing Post, or Self Oiler.—The oiling of pigs as a remedy for lice is a messy operation which can, to a large extent, be avoided by the use of this device. It consists of a wooden post driven securely into the ground and round which an old sack is tied. The sack is kept saturated with oil (practically any variety, such as old sump oil, will do). By rubbing themselves against it the pigs keep themselves oiled, but frequent applications of oil to the sack are necessary to render it fully effective when lice are troublesome.

Shipping Crate.—Figure 4 shows a shipping crate designed to meet the requirements of a farmer who was sending pigs to market by the railway road motor service. The journey occupied two days, and it was necessary to provide means by which the animals could be fed and watered *en route* without allowing them out of the crate. For shorter journeys the feeding arrangement is unnecessary. This particular crate was designed to carry two animals weighing 180 lbs. each, but the following table of sizes published by the University of Missouri may be found useful in arriving at the dimensions of crates for individual requirements:—

Weight of hog (lbs.)	Length of crate (inches)	Width of crate (inches)	Height of crate (inches)
25 to 75 …… …… …… ……	35	12	23
75 to 150 …… …… …… ……	46	18	28
150 to 250 …… …… …… ……	54	20	34
250 to 350 …… …… …… ……	60	20	38
350 to 500 …… …… …… ……	64	24	40
500 to 800 …… …… …… ……	80	30	48
800 to 1,000…… …… …… ……	84	30	50

It is suggested that a crate to carry two animals should be made somewhat wider and shorter than the dimensions given for a single animal of equivalent weight.

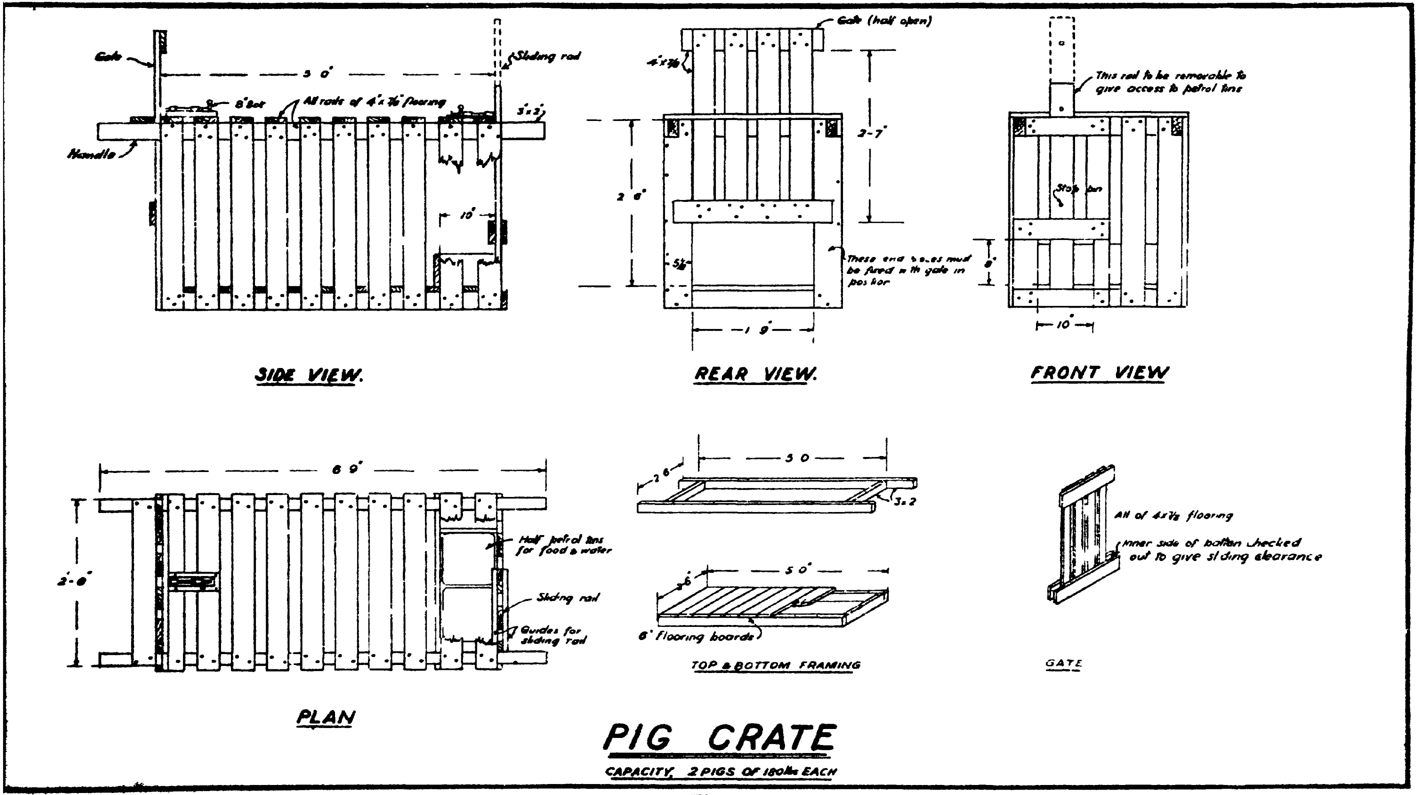

Gate
Sliding rail
5' 0"
8" Bolt
All rails of 4" x 7/8" flooring
3" x 2"
Handle
10"
SIDE VIEW.
Gate (half open)
4" x 7/8"
2' 7"
2' 6"
5 1/2"
These end boxes must be fixed with gate in position
1' 9"
REAR VIEW.
This rail to be removable to give access to petrol tins
Stop bar
8"
10"
FRONT VIEW
6' 9"
2' 6"
Half petrol tins for food & water
Sliding rail
Guides for sliding rail
PLAN
2' 6"
5' 0"
3 x 2
5' 0"
2' 6"
6" flooring boards
TOP & BOTTOM FRAMING
All of 4 x 7/8 flooring
Inner side of batten checked out to give sliding clearance
GATE
PIG CRATE
CAPACITY, 2 PIGS OF 180lbs EACH

Fig. 4.

Unless some suitable timber is available, such as a motor car packing case, ordinary 4 inch and 6 inch flooring can be used, the tongues and grooves being first removed, as the former will splinter and the latter collect dirt and vermin. The gate and sliding rail which gives access to the feed and water tins are each kept closed by ordinary tower bolts, or special locking bolts which can be secured with a padlock may be used if desired. The whole crate should be assembled with wood screws, as nails will soon work loose. The cost of materials for the crate illustrated would be approximately 30s.

Concrete and Cement Work.—As cement figures rather largely in the building of a permanent piggery, some of the more important points to be observed in its use for making concrete and cement plaster are given here, but for more detailed instructions the reader is referred to an article entitled "Concrete on the Farm," by N. P. Sellick, which was published in this Journal in April, 1926, and which is available as Bulletin No. 588.

Cement deteriorates rapidly in storage, and only fresh stocks should be used for permanent work. All sand used for concrete or cement plaster should be clean, sharp river sand which should not contain a large proportion of dust or fine particles. Sand containing dust or clay can be made useable by washing, but for any but small quantities this is rather a laborious business. Any hard, clean stone, such as granite, diorite or quartzite may be used as an aggregate, but friable or oxidised stone is useless. The stone should be crushed so that no pieces are larger than that required for the particular job.

The water used for mixing cement should be clean and reasonably free from dissolved impurities.

The ingredients of concrete or cement mortar should be accurately measured to give the proportion required, by the use of paraffin tins, or for large quantities, proper measuring boxes. These consist of four sides, but have no top or bottom, and should be so proportioned that they contain some even number of cubic feet.

As the inclusion of earth or clay seriously affects the strength of cement mixtures, the mixing must not be done on the bare ground, but on a proper platform of wood or iron or on an existing cement floor.

The cement and sand should be thoroughly mixed, first while quite dry, after which the stone, which may with advantage have been previously wetted, is added. The whole should again be thoroughly mixed, being turned completely over at least twice before the water is added, which is best done by means of a watering can fitted with a rose. As soon as the water is added the concrete or mortar must be mixed thoroughly and as quickly as possible. Only sufficient water should be added to reduce the mass to a workable consistency, as any excess of water tends to wash away the cement and also reduces the ultimate strength of the concrete. It will be found that in the final stages of the operation the mixing alone will reduce the mass to a more liquid consistency without the addition of more water.

All cement mixtures, whether concrete, mortar or plaster, should be placed and finished off within 30 minutes from the time the water is first added.

Cement work, after being finished, must be "cured" by being kept damp for as long as possible; a concrete floor should be covered over with wet sacks or clean grass and kept continually wet for at least seven days; if circumstances permit this period may be doubled or trebled with advantage.

In the case of concrete plastered walls of a piggery, the same course should be adopted as far as possible, although it is not so easily done, but even if continued for a day or two, the ultimate hardness of the plaster will be very considerably increased.

Quantities.—For estimating purposes, a list of the more important materials required for the construction of a unit of six complete pens and yards only, similar to those shown in plate 1, is given herewith:—

Quantities of Six Pens and Yards.

Item	Quantity.
Bricks	18,500
Lime	19 bags
Damp course, 26 g. gal. iron	15 sheets
Alternative damp coursce, 3-ply felt	25 yards
Cement for concrete floors	90 pockets
Alternative cement for grouting masonry floors	12 pockets
Cement for plastering walls	40 pockets.
Timber for roofing, 6in. x 2in. x 16ft.	6 lengths
Timber for roofing, 6in. x 2in. x 18 ft.	6 lengths
Roof iron, 24 gauge, 12ft. long	36 sheets
Roofing screws and washers	2½ gross
Timber for gate, 6in. x ⅞in. x 14ft. flooring	9 lengths
Timber for gate posts 3in. x 1½in. x 14ft.	3 lengths
Tee hinges, 18in.	12
Bolts for securing gate posts, 24in. x ½in.	6
Bolts for securing gate posts, 9in. x ½in.	12

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Farming Calendar

JANUARY.

CITRUS FRUITS.

The planting of citrus trees should be completed if possible by the end of the month, for trees planted later may not harden up before the winter; they then become susceptible to winter injury from cold. This month is the best one for planting shelter belts to protect all varieties of fruit trees from the prevailing dry winds. Cover or green crops may be planted during this month; if the grove has been over-run with grass or weeds, sow the cover crop seed more thickly. This will assist in smothering future weed growth. Continue suppressing any undesirable shoots that may develop on the tree trunk or other parts of the tree. Drain any depressions that allow rain or irrigation water to accumulate at the base of the trees, for trees permitted to stand in water will speedily fall victims to disease or pest injury.

DECIDUOUS FRUITS.

Continue planting cover or green crops between the trees. These crops may then be turned under towards the end of the rainy season to furnish the necessary humus.

Summer pruning may be continued. Rub or break off any undesirable shoots that have a tendency to crowd each other; suppress all growths on the main stem from the ground level up to the main arms of the tree, for these are unnecessary. If next year's fruit crop is to be of good size and quality, the inner fruiting wood of a tree must receive sufficient air and light to mature fully. If the new growth is too dense it will prevent the fruiting wood from maturing, and poor crops will be the result. The thinning out of the summer growth will overcome this crowding and weakening of the fruiting wood.

Many fruits will be ripening during the month. Do not permit the fruit to become over-ripe on the trees; rather harvest it at the correct stage and store or sell the surplus.

Plant shelter trees if the orchard is exposed to the prevailing winds, as good crops of fruit cannot be expected from inadequately protected fruit trees.

CROPS.

If not already sown, put in the ensilage and fodder crops at once, such as maize and legumes, oats and other hay grass crops. Sow short season crops like haricot beans, linseed, buckwheat, peas, summer oats, gram and mung bean. Plant out grasses and kudzu vine for pasture. Ridge potatoes and cultivate thoroughly. Main crop can still be planted. Quick growing green manuring crops, such as cowpeas, soya beans and sunnhemp, may still be sown this month. Earth up ground nuts so that a small amount of loose soil is thrown over the crowns of the plants. This assists the formation of nuts. If not already done and where practised, legumes or long season oats such as Algerian can be sown under the maize crop for grazing and to add nitrogen and humus to the soil. Cultivate all growing crops well, and thoroughly eradicate weeds. Overhaul all hay-making implements and ploughs and get in thorough repair in preparation for the haying and ploughing seasons. Endeavour to mow grass fields early for hay and litter, and to obtain second cutting for hay in April. Fallowed lands or fields not yet planted may be disc-harrowed or ploughed to prevent weeds from seeding. Mow grass paddocks infested with annual weeds to prevent the weeds seeding. Prevent Mexican marigold and other noxious weeds seeding by hoeing or pulling out the plants by hand. Keep a sharp look-out for maize stalk borer. Cut off the tops of infested plants or treat them with a recognised chemical preparation. If topping is practised, remove tops from land, and bury, burn or feed them at once to farm stock. Watch the maize lands for witchweed. Prevent witchweed plants from seeding by cultivation and by hand-pulling the plants. Make as much manure as possible by placing grass and litter in cattle kraals, pig sties and stables. If there is stumping and clearing to be done, push on with it. Endeavour to get as much of the new virgin land as possible broken up during this and the two following months.

FLOWER GARDEN.

This month requires all one's energy in the flower garden. Annuals may still be sown for late flowering before the season is over. Planting out should be done as early as the weather permits, and advantage taken of a dull day after a shower for this work. If care be exercised much smaller plants may be put out than would at first be thought advisable, as with attention these will make stronger plants than larger ones, which are more likely to receive a check. The soil requires constant stirring, owing to the packing caused by the rains and for the eradication of weeds, which are now very troublesome. All plants should be kept free of dead and decaying matter.

VEGETABLE GARDEN.

Turnips, carrots, cabbages, lettuce, etc., may be sown for carrying on during the winter months. Potatoes may be planted this month for keeping through the winter. Weeding and cultivating between the rows should be continually carried on.

FORESTRY.

If the rains are seasonable, plant out evergreen trees, such as gums, cypress, pines, etc. Fill in all blanks as soon as they are noticed, and do not leave them until the following season. Planting should be done on a wet day, or, failing that, on a dull day, or late in the afternoon. Great care should be taken to see that the trees are not planted out any deeper than they stood in the tins.

POULTRY.

All houses must be absolutely watertight, the floor raised well above the level of the surrounding ground, thus preventing water seeping in and making it damp. The birds themselves should not get wet, and no pools of water should be seen in the runs.

Foodstuffs must be kept absolutely dry, otherwise they will become mouldy and sour, causing disturbance of the intestinal tract, illness, and perhaps death; certainly diminution in the number of eggs.

Some of the birds will now be in moult. To get them through it quickly give more sunflower seed, some monkey nuts, plenty of green food, especially cabbage, kale, etc., plenty of milk or some meat, a little sulphur in the dry mash (one teaspoonful to 1 lb.); also stew two dessertspoonfuls of linseed in a pint of water to a jelly, mix this to a crumbly consistency with mealie meal or bran and give about one dessertspoonful to each bird daily. Keep the birds dry during the rains, otherwise the egg output will decrease.

Do not hatch any more turkeys till after the rainy season is over. Turkeys should not be penned up, but allowed on free range.

Ducks must be treated in almost exactly the reverse manner to what turkeys are. They should be kept in a small run; nearly all their food should be wet mash, bran, pollard, mealie meal, meat meal and milk, as much as they will eat three times a day, *i.e.*, they should practically be allowed to spend their existence eating and sleeping. Big duck breeders often give a fourth meal by lamplight at 10 p.m., and the first meal is given at sunrise.

STOCK.

Cattle.—Put the bulls into the herd now to secure spring calves. The bulls should be in good condition at the commencement of the service season and their condition should be maintained while they are working. This season calves should be looking well by this time and care must be taken not to over-milk the cows in consequence. Cows rearing calves should not be milked more than once a day. Hand-reared calves should be kept in dry, clean quarters. In the warmer weather they often do better if they are kept indoors until they are three or four months of age. Bullocks which are being fattened on grass should receive a concentrate ration from now onwards. During this month a protein concentrate should usually be added to the milch cows' ration.

Sheep.—Keep the sleeping quarters as dry as possible. Keep the sheep away from vleis and "rotate" the grazing as much as possible. Sheep are liable to suffer severely from internal parasites from now onwards.

DAIRYING.

During the months of December and January veld grazing is usually plentiful, and very little extra feed in the form of concentrates is required for dairy stock. It should be borne in mind, however, that heavy milking cows are unable to satisfy their requirements for milk production from veld grazing alone, and should receive a daily allowance of grain; the latter should be fed at the rate of 2 lbs. for every gallon of milk produced daily, *i.e.*, a cow producing three gallons of milk should receive 6 to 7 lbs. of concentrates. An excellent mixture for this purpose is one consisting of four parts of maize meal and one part of ground-nut cake.

During wet weather, the provision of a clean dry shelter for calves is essential; the latter should not be crowded together in a small, damp, badly ventilated pen or muddy kraal. When treated in this manner, a calf is very liable to contract various ailments such as scour, etc. Scour is entirely preventable, and is usually caused by over feeding, or feeding from dirty pails, feed boxes, etc. Calves which contract scour should be isolated, the milk ration reduced, and they should be dosed with a few tablespoonfuls of castor oil.

Under the weather conditions which now obtain, cream should be despatched to the creamery at least three times a week. It is of the greatest importance that cream should be cooled immediately after separation, and should be kept cool while on the farm and whilst in transit to the railway station or siding. While the cream is being cooled, it should be frequently stirred, using a stirrer with a plunger attachment. Warm, freshly separated cream should not be mixed with old cream which has already been cooled. Cool the fresh cream first and then mix thoroughly with the old cream. Gassiness is a common defect in the cream received at the creameries at this time of the year, and is caused by gas-producing organisms with which the milk and cream are contaminated. These organisms abound in mud, manure, etc., and develop and multiply very rapidly at high temperatures. Any precautions therefore which may be taken to eliminate dirt, manure, etc., from the milk and to keep the cream cool will prevent the development of gassiness.

As the night temperatures are fairly high, cheese-makers should not attempt to use night's milk for cheese-making; morning milk plus a starter will give the best results. Gouda cheese-making operations are not usually successful at this season of the year, owing to the poor quality of the milk and the prevalence of gassiness. This type of cheese is best manufactured during March and subsequent months.

TOBACCO.

Cultivation should be systematically continued, and no foreign vegetation allowed in the tobacco field, as weeds and grass induce insect attacks. All backward plants should be given special attention, and an additional application of fertiliser to hasten growth, so that the plants ripen as uniformly as possible. Curing barns should be placed in proper condition on rainy days, and all tobacco appliances should be placed in proper order for the rush of work during the curing season. Early planted tobacco may be ready for topping during the latter part of the month, and the common mistake of topping too high should be avoided. Go over the field carefully and select typical, uniform and disease-free plants for producing seed for next season's crop. All plants should be properly primed at the same time that the tobacco is topped.

VETERINARY.

Horse-sickness may now be expected, especially in districts where early heavy rains have occurred. Blue tongue in sheep will also be prevalent.

Turkish Tobacco

CULTURE AND MARKETING IN SOUTHERN RHODESIA.

(Continued).

By J. C. Collins, B.Sc., Assistant Tobacco Officer.

Ripening.—Too much emphasis cannot be laid on the fact that the finest flavour and smoking quality of the cured leaf is due to the natural changes which occur in ripening while the leaf remains on the plant.

As in the case of cereals, there are various stages of ripeness. It follows therefore that the leaf must be picked at the correct stage of ripeness. If the leaf is harvested when under ripe, that is on the green side, the cured product will be dark in colour and bitter in flavour. On the other hand, over-ripe leaf will cure out thin and papery and be lacking in flavour and aroma.

When a leaf is allowed to remain on the tobacco plant beyond the stage of ripeness at which it should be reaped, a bright yellow colour suggestive of full ripeness will commence to show at the tip and then gradually spread over the entire surface of the leaf. As this bright yellow colour spreads, it will be followed by a browning indicative of decay, so that before the portion of the leaf closest to the stem has become fully ripe, the opposite extremity has already commenced to decay. This implies that the leaf must be reaped before this stage of "full" ripeness has been reached.

As with maize and other plants, the leaves of a tobacco plant ripen progressively from the base of the plant upwards. The number of leaves on an individual plant ready for harvesting at the one time varies considerably; there may be only the one or there may be as many as five or six, but, generally speaking, three or four reach the correct degree of maturity simultaneously.

During growth the leaves are soft and pliable and of a deep green colour. As the plant grows, however, the leaves increase in surface area and thickness due to the accumulation of food material.

When the leaf has reached full growth, from being soft and pliable, it becomes somewhat rough and brittle, due principally to the accumulation of starch granules in the cells.

Though the leaf is now fully grown, it does not mean that it is necessarily ripe enough for harvesting. As in the case of an apple tree, although the fruit may have become fully developed, it is not ready for picking until there is an indication of change of colour, so in the case of the tobacco leaf the grower must await a yellowing.

The colour of the leaf will gradually transform from a comparatively deep green to a greenish yellow. The change will first be observed in the region of the tips and edges of the leaf and from there will gradually extend inwards. This yellowing will be more pronounced in light bodied leaf. In leaf of heavy texture the correct degree of ripeness will be indicated by the appearance of yellow flecks over the surface and by the brittleness of the veins and mid-rib. If a portion of the leaf is pressed between finger and thumb, it should crack across the fold.

Perhaps the best indications of ripeness are a definite change of colour in that portion of the leaf closest to the stalk of the plant, coupled with a tendency for the leaf to bend over in the direction of the ground or to assume a slightly horizontal position.

Again emphasis is laid on the important bearing that the correct degree of ripeness has on the colour and quality of the cured product. In determining ripeness no indicative factor should be considered separately, but all the characteristics referred to above should be considered collectively.

Harvesting.—Turkish type tobacco is harvested by the single leaf method. That is, as a leaf reaches the correct degree of ripeness on the plant, it is picked and cured.

Harvesting should be done in the early hours of the morning before the sun has had time to cause the plants to wilt. If there should have been heavy dew during the night, picking should be delayed sufficiently long to allow the leaves to dry.

On no account should leaf be harvested immediately after a heavy shower of rain, as the gum which accumulates on the leaf during dry weather and improves its quality, is washed off by the rain. It is not always possible, but when circumstances permit, it is beneficial to delay reaping for a day or two after a heavy downpour.

When there is not much variation in the character of the soil of a particular field and where seedlings of uniform size were transplanted and uniform growth has been made, harvesting will be much facilitated, as at each picking approximately the same number of leaves can be reaped from the different plants, and as these leaves will occupy approximately the same positions on the plants, they will approximate each other in size and texture which will be a great advantage in curing and will greatly facilitate grading.

At all times great care should be exercised in handling tobacco leaf. At the harvesting stage it is very tender and crisp and will be easily bruised if not properly handled.

As soon as the leaves have been harvested, they are carefully laid in the small baskets made by the labourers on the farm and are carried to the homestead. The baskets should be covered with cloth or other suitable covering material to protect the leaves from the sun.

Stringing and Preliminary Grading.—In some shady spot such as a shed or under a tree or in an improvised grass shelter, the leaves are roughly graded according to size and colour. All diseased, perished and damaged leaf is put to one side and graded separately. This preliminary grading does not take up much time and through it a much more uniform cure of the different types of leaf is attained, thus affecting a considerable saving of time and labour when it comes to grading the cured product.

Stringing is the next operation. It is done with the aid of a thin flat steel needle from 18 to 26 inches long threaded through the eye with good quality twine.

The needle is passed through the mid-rib of each leaf separately and about half an inch from the butt. All leaves should face the same way and only leaves of the one grade should appear on the needle. When the needle has its complete complement of leaves, the latter are carefully moved along on to the string and the operation is repeated. Strings are normally cut to lengths of about nine feet and carry three 24-inch needles full of leaf. This quantity allows plenty of space for manipulating the leaf on the string during curing operations.

Curing.—In former times there was a ready demand for leaf dark in colour. To-day, however, the manufacturer requires leaf varying in colour from lemon to light mahogany, and as a result of this change in demand the grower no longer makes use of a cellar or wilting room before placing the strings of tobacco on the curing racks, as that practice resulted in the leaf sweating and curing out dark.

Now, as soon as stringing has been completed, the strings are tied on to the curing racks These racks are constructed in a locality sheltered from the prevailing winds but fully exposed to the sun. There should be no tall trees or buildings in the immediate vicinity, as they would produce shadows over portions of the curing tobacco and so hamper uniform curing, since some strings would receive considerably more direct sunlight than others.

The curing racks consist of two parallel rows of short stout poles about five feet long let vertically into the ground to a depth of two feet. A convenient distance between the rows is three feet; it should not exceed more than four feet because, if too wide, the labourer finds difficulty in manipulating strings along the centre of the rack and in endeavouring to reach them may damage the outside rows.

The posts in the line should be spaced about nine feet apart. The construction of the rack is completed by stretching heavy gauge wire over the tops of the posts from one end of the line to the other.

Briefly, the rack comprises two parallel strands of wire drawn taut and supported by stout vertical poles at a height of about three feet above ground level. The rack may be made any length desired but should not exceed four feet in width. Preferably the racks should run in a north and south direction, so that the leaves on them will receive a maximum amount of sun.

Across the two wires at distances of eight feet six inches to nine feet, straight sticks are fastened firmly. To these the laden strings are tied in rows parallel to the wires.

The parallel strings of tobacco should be tied sufficiently far apart to prevent the leaves of one string coming in contact with those of another. This will reduce the risk of excess fermentation setting in and will allow of sun and air reaching the leaves on each string.

The principles underlying the curing of Turkish tobacco are the same as those employed in curing flue-cured Virginia. In the case of the latter, however, the grower is in a much more fortunate position in that the leaf is cured in barns with the aid of artificial heat so that he has a relatively easy task in obtaining the requisite degrees of humidity and temperature. In the case of Turkish, however, curing is done in the open, and as the grower has no control over the climatic elements, he has to regulate the rate of cure by manipulating the leaves on the strings.

Curing differs from a true drying problem in that it is a physiological process involving both physical and chemical changes in the leaf.(⁹).

In an article of this nature there is no room to elaborate on scientific detail but suffice to say that in curing there are three essential stages—the yellowing period, the fixing period and the drying period.

1. *The Yellowing Period.*—During the life of the plant, food material is stored in the leaf. In the curing process this food is consumed and the chlorophyll (green colouring matter) undergoes chemical action resulting in a change in the colour of the leaf from green to yellow. This process can only be carried out while the leaf is alive, and it follows, therefore, that one must guard against excessive elimination of water or moisture, for water is essential to life.

This yellowing period is of vital importance in curing, because on it depends the colour and quality of the final product. If the leaf is allowed to dry out too quickly, the cells will be killed and the necessary change in colour will be prevented.

2. *The Fixing Period.*—Once the colour of the leaf has changed from green to lemon, it is necessary that the action be restricted from proceeding any further, otherwise the leaf will tend to cure out too dark in colour. This is done by eliminating water from the leaf tissue; in other words, by allowing the leaf gradually to dry out. The leaf may now be considered killed.

3. *The Drying Period.*—This resolves itself into a true drying stage. Although the leaf has been killed through the removal of most of its moisture during the fixing period, a certain amount of water will still be held in the stem and mid-rib, and this must be got rid of completely before the leaf is removed from the racks, otherwise the tobacco will be rendered valueless as a result of excessive fermentation setting in during storage.

To put these principles into practice the following procedure is adopted. Immediately after the laden strings have been tied on to the curing rack in the manner previously described, they are covered with a layer of loose grass or hay to a depth of about 12 inches.

The grass will be left on the rack for two or three days, depending upon the humidity of the atmosphere and the rate at which the change in colour is taking place. At the commencement of the curing season when the atmosphere is fairly humid, it may be necessary only to cover the leaf for the first day and thereafter only during the hottest hours of the day, but as the season progresses, the grass will have to be left on for considerably longer.

The function of the grass is to protect the leaf from drying out too quickly—in other words, to protect against excessive loss of water from the leaf tissue during the yellowing period.

Once the appropriate colour changes have taken place, the yellow must be fixed by the water in the leaf tissues being gradually eliminated. Consequently the grass is removed in the early mornings and replaced at night. This operation is continued daily until the leaf has been completely dried.

The importance attached to preliminary grading before stringing will be fully appreciated during curing operations. If all leaves on the string are of the same size, colour and texture, and if all neighbouring strings on the curing rack are of similar grade, then the leaves will tend to cure out uniformly. If, on the other hand, sufficient attention has not been paid to preliminary grading and to maintaining a uniformity in type of the neighbouring strings on the rack, then considerable difficulty in curing will be experienced, for some leaves will be curing out faster than others and, as it will not be possible to vary the curing for each, much loss will be sustained in the quality of the final product. The difficulty will not only rest at curing but will also make itself felt at the final grading.

Just as in flue-curing, so in the curing of Turkish, unless strict attention is paid, the leaf will tend to sponge or sweat owing to moisture collecting on the surface and causing excessive oxidation.

Sponging or sweating in Turkish tobacco is generally indicated by a dark reddish brown colour appearing near the butt of the leaf and gradually extending along both sides of the mid-rib. If not checked in time, the entire leaf will take on an unpleasant dark appearance.

In flue-curing operations this trouble may be overcome by reducing the humidity of the barn and by increasing the ventilation. In sun-curing the parallel procedure is to manipulate the leaf. For instance, as soon as the leaf is observed to be sponging or sweating the leaves on the string should be separated from each other just a little so as to allow more air to play through them and thus induce more rapid drying. Care should be taken not to separate the leaves too far apart, as that would result in the leaf drying out excessively fast and adversely affecting quality.

As indicated previously under the heading of "Climate," the incidence of rain may cause considerable damage to leaf on the curing rack. Whenever a heavy shower is threatening it is advisable to carefully transfer the strings to some suitable shed and keep them there until such time as the storm lasts. Such action, however, is not always possible, particularly when dealing with a very large number of strings, and in such cases the only course open to the grower is to protect the leaf on the rack by covering it with a particularly thick layer of loose grass. Remove the wet grass as soon as the rain has ceased.

Ideal protection is, of course, provided by canvas shelters fitted with rollers and erected over the racks so that the covering can be raised or lowered as climatic conditions determine. Canvas, however, is a relatively expensive item in this Colony and in consequence recourse is almost universally made to grass.

As dew also exerts a detrimental effect on the leaf by causing it to discolour, the covering of grass which has been removed in the morning should invariably be replaced at night. Always see that the grass overlaps the sides of the rack and so protects the outside rows of strings.

The leaf should remain on the rack until all moisture has been completely removed not only from the web of the leaf but also from the mid-rib and stem. The time taken to reach this stage will vary from two weeks to about six weeks from the time the leaf was first placed on the rack.

Curing takes considerably longer at the end of the season than it does in April and May owing to the atmosphere being drier and the nights being so much colder.

Handling and Grading Cured Leaf.—The best time of day for removing the cured leaf from the racks is in the early hours of the morning when the leaf is soft and pliable owing to the moist conditions pertaining overnight. If removed during the heat of the day the leaf is brittle and as a result much loss will be sustained through damage incurred in handling.

As the strings are removed from the racks they should be suspended from the roof of a shed or from the tiers of a tobacco barn, either in the form of wreaths or hanging straight down, or in any other convenient manner.

When required for grading the brittle leaf is again brought into condition suitable for safe handling by introducing moisture into the building in which it has been stored. This is done by placing a layer of grass to a depth of six or eight inches on the floor and wetting thoroughly with water. Keeping the doors of the building open overnight will tend to hasten the operation.

Steam has a detrimental effect on the quality of Turkish leaf; its use for conditioning purposes is therefore not advocated.

In grading, each string should be manipulated separately. All leaf foreign to the general run of the strings should be removed so that on the string there remain only leaves which are similar in size, colour and texture.

If the preliminary grading before stringing was carried out properly and due attention was paid to keeping only strings bearing leaves similar in size, colour and texture contiguous to each other on the curing rack, and if a similar precaution was taken when transferring the cured strings from the racks to the storage room, then little or no difficulty will be experienced at this final grading.

All leaves removed from the strings should be graded according to size, colour and texture and be baled as loose leaf.

During the growth of the plant in the field, a certain amount of sand adheres to the surface of the leaf, particularly to leaves at the base of the plant. Similarly dust and bits of grass, etc., find their way into the strings on the curing racks. At the time of final grading, therefore, it becomes necessary to remove all foreign matter.

Grass and straw are best removed by hand, whilst sand and dust may be got rid of by shaking the strings. Particularly dirty leaves will require to be cleaned with monkey-tail brushes.

The standard of cleanliness required will be determined by the channel through which the tobacco is to be marketed. For instance, the Turkish Tobacco Co-operative Company of Rhodesia, Limited, requires its members to merely shake out as much foreign matter as possible but not to go to the trouble of brushing each leaf, the idea being to minimise working costs on the farm seeing that the tobacco will ultimately be thoroughly cleaned by hand and machinery at the Company's warehouse before it is blended and shipped for export. On the other hand certain brokers will not touch leaf which has not been brushed, whereas others again will be prepared to handle uncleaned and even ungraded leaf.

This last method of disposal may appeal to certain people, particularly to beginners in the industry who may be doubtful of their capabilities in handling leaf, but they should always remember that brokers and buyers are not philanthropists but business men and that when quoting prices they will always take into account the amount of foreign matter contained in the bale. The buyer cannot be expected to pay for sand and grass. Generally speaking, it will always pay the grower to make a really good job of the work himself. Grading is not a difficult problem if the few suggestions previously referred to are observed.

The work is simplified even further if, instead of using tables, the strings are suspended parallel to the ground and at a convenient height (eye level) between two vertical poles let into the floor of the grading shed. The poles should be sufficiently far apart to just allow of the strings being tied to them. The grader, after shaking the string two or three times, ties it to the two poles and proceeds to grade. Each time he pulls off a leaf he automatically jerks the string, thus causing more dust to be shaken out. As leaves foreign to the general run of the string are removed from it, they are dropped into separate baskets (placed on the ground) according to their respective grades. Before untying the string the grader should satisfy himself that no straw or grass is remaining and then twang the string between finger and thumb to shake off more loose sand. As previously stated, any leaf which is particularly dirty and which does not respond satisfactorily to this simple treatment should be cleaned by brushing.

The loose leaf contained in the baskets should be subjected to a further inspection—this time on grading tables—to ensure that it has been properly sorted into its appropriate grades.

When a sufficient quantity of leaf has been cleaned and graded it is brought into suitable condition for handling and storage by subjecting it to fairly moist atmospheric conditions. It is then packed in the form of bales.

Baling.—There are three systems of baling open to the grower, and here again choice is determined by the channel through which the tobacco is to be marketed.

1. Certain buyers require the bale to be tonga packed. Tonga packing means that the graded and cleaned leaf is removed from the strings and "poured" into the baling box regardless of the direction in which tips, butts and surfaces are pointing. The leaf must be dispersed uniformly throughout the box and must not be allowed to form heaps or lumps, as such a state of affairs would prevent a uniform temperature being maintained and so result in fermentation proceeding more rapidly in certain parts of the bale than in others.

2. *Straight-laid Packing.*—This is the system which has been in force in this Colony since the establishment of the industry. It is fast giving way, however, to the more modern system of tonga packing. For the benefit of those persons who are still required to pack straight-laid, the following procedure is advocated.

The strings are cut to the length of the baling box and are placed lengthways in it with the butts of the leaves pointing outwards and the tips towards the centre of the box. As soon as the bottom layer has been completed, successive layers of strings are packed in similar fashion until the bale is of the requisite weight—approximately 80 to 90 lbs.

Loose leaf is packed in a similar fashion.

In both these systems of packing, care must be exercised in the application of pressure. If the bale is pressed down too tightly the leaf will be bruised and will tend to set in compact masses difficult to separate. On the other hand, if insufficient pressure has been applied, the leaf will tend to dry out too rapidly as a result of excessive aeration.

Once packing has been completed the bale should be allowed to set under pressure for several hours before it is sewn in good quality hessian.

The base, one end and the top of the bale are covered with the hessian, which is laced firmly in position by stout cord drawn from the top to the bottom of the bale along the three open sides.

The bale is then labelled according to grade and weight and is held in store until ready for shipment from the farm.

During storage the bales should be frequently examined to see that they are maintaining proper condition and are not drying out nor heating. The condition to be aimed at is good handling condition. In other words, the leaf should not crackle when handled nor should it feel soft and damp.

If the leaf shows a tendency to dry out, the humidity of the storage room should be increased or else the bale should be removed to a more moist atmosphere.

On the other hand, if there is any indication of the bale heating through the tobacco having been packed in high condition or through exposure to excessively humid conditions, the lacing should be slackened immediately and the bale be placed on end and the contents loosened so as to allow air to play through the leaf, particularly in the centre of the bale. After being sufficiently aired, the bale is again laced and stored away.

Just prior to despatch from the farm, the bale should be completely encased in D.W. Compo (a composite material consisting of baling paper and hessian), or in special quality baling paper superimposed by good quality hessian to protect the leaf from drying out and losing condition during the long journey.

The standard weight of a bale of Turkish tobacco is from 80 to 90 lbs. packed weight.

3. *Baling for Despatch to the Co-operative Company's Warehouse at Darwendale.*—After the tobacco has been cleaned and graded according to the standard required by the Turkish Tobacco Co-operative Company of Rhodesia, Limited, it is baled (in Virginia type baling boxes) on the strings in straight-laid fashion. The strings should not be cut, even if they are too long for the box, but the ends should be doubled over. Loose leaf is also packed straight laid.

No mechanical press should be used during packing, the weight of a labourer being considered sufficient for the purpose. Bales should weigh about 75 lbs. and should be encased in D.W. Compo or in baling paper superimposed by good quality hessian.

Marketing.—Mention has already been made of the three systems of marketing open to the producer, *viz.* (*a*) by disposal direct to a manufacturer, (*b*) by disposal to a manufacturer through the medium of an agent or broker, and (*c*) by disposal through the Turkish Tobacco Co-operative Company of Rhodesia, Limited.

Seeing that the vast majority of growers in this Colony are members of the Co-operative Company, it is considered advisable to briefly describe the Company's system of operation as far as the handling and marketing of their crop is concerned.

As its name implies, the Company is a co-operative body whose members are producer-shareholders. The warehouse is situated at Darwendale—the main Turkish tobacco producing district of Southern Rhodesia.

Each member is required to clean, grade and bale his crop on the farm in the manner already described under the headings of "Handling and Grading of Cured Leaf" and "Baling."

Grading should commence as early in the season as possible so as to give the tobacco time to commence maturing in the bale before it is sent in September to the Company's warehouse for classification and further handling.

The member receives an initial payment on his crop based on the grades into which it is classified and therefore it should be the aim of every grower to send his crop into the warehouse in good heart. Dryness and the presence of sand and dust naturally detract from the appearance of the leaf. Whereas a bale in too high condition will tend to heat and take on a musty smell through excessive fermentation setting in and the leaf will be completely destroyed if precautionary measures are not taken at an early stage.

Condition is best maintained by storing the bales not more than three deep in underground cellars. Each bale should be examined every few days and at the slightest inkling of the tobacco heating, it must be removed from the cellar and the bale in question be opened to allow air to play through the leaves, particularly in the centre of the bale. When dry the bale is again sewn up and stored in the cellar.

Every bale sent into the central warehouse is classified by two experienced members appointed by the Company. At the request of the Company, arrangements are made by the Department of Agriculture for a Government Tobacco Officer to be present at these classifications whenever possible. The duty of this official is to act as arbitrator in the event of the two classifiers not being able to arrive at a unanimous decision and to see that classification is carried out in accordance with the scheme agreed upon at the commencement of operations.

The bales are then stored in cellars according to their classification grades. As soon as facilities permit the tobacco is cleaned and graded, the leaf being removed from the strings. It is then stored in large bins according to its different grades. From these bins the leaves are passed over a mechanical shaker to remove any remaining sand, and are next packed "Tonga" fashion.

The bales are then transferred to a suitably constructed storage room where they receive expert attention while undergoing fermentation prior to being shipped for export.

Prospects.—In times such as these when the war is spreading from country to country, it is impossible to forecast with any degree of accuracy, the prospects of the industry. One can only base one's opinions on present-day demands and a comparison of present-day production figures with those of the past.

Table I. shows the exports, by countries of destination, of Southern Rhodesian grown Turkish type tobacco. From these figures it will be seen that, over the period 1934-35 to 1939-40, the United Kingdom and the Union of South Africa were our two major importing countries. In the case of the Union, however, our exports have been markedly dwindling—so much so that in the export season 1939-40 there was no export of Turkish to that country, brought about by the Union Government declining to grant a duty-free quote to Rhodesia in an endeavour to further production in their own country.

Exports to the United Kingdom, on the other hand, though fluctuating somewhat between seasons 1934-35 to 1936-37, thereafter show marked increases in the weight of tobacco exported year by year.

To appreciate fully the importance of the United Kingdom market to the Southern Rhodesia Turkish tobacco grower, the exports should be expressed in terms of percentages of the total exports from the Colony. This information is supplied in Table II.

TABLE I.

Exports of Southern Rhodesia Turkish Tobacco (unmanufactured) by Countries of Destination.

*Season.	1934-35. lbs.	1935-36. lbs.	1936-37. lbs.	1937-38. lbs.	1938-39. lbs.	1939-40. lbs.
United Kingdom	227,534	157,353	187,159	360,841	757,620	550,527
Union of S.A.	465,816	253,985	175,939	145,900	72,040	—
Port. E. Africa	10,600	—	—	490	1,030	4,636
Belgium	—	35,123	41,580	22,745	—	—
Argentine	-	6,598	13,036	—	4,961	—
Holland	—	—	37,772	22,798	17,698	11,898
Other countries	387	—	3,835	22,611	29,069	119,256
Total exports	704,397	453,059	459,321	581,385	882,418	686,317

*The export season is considered as commencing on the 1st April of each year and terminating on the 31st March of the succeeding calendar year.

TABLE II.

Figures in Table I. expressed as percentages of Total Exports.

Season.	1934-35 %	1935-36. %	1936-37. %	1937-38. %	1938-39. %	1939-40. %
United Kingdom	32.30	34.73	40.75	62.07	85.86	80.21
Union of S.A.	66.13	56.05	38.30	25.10	8.16	—
Port E. Africa	1.51	—	—	0.08	0.12	0.68
Belgium	—	7.75	9.05	3.91	—	—
Argentine	—	1.46	2.84	—	0.56	—
Holland	—	—	8.22	3.92	2.01	1.73
Other countries	0.05	—	0.84	3.89	3.29	17.38
Total exports, lbs.	704,397	453,059	459,321	581,385	882,418	686,317

TABLE III.

Estimated Production of Turkish Type Tobacco in Southern Rhodesia during 1939/40, compared with final figures for twelve previous Seasons.

Season.	Acreage.	Yield. lbs.	Average yield per acre. lbs.
1927-28	911	451,580	496
1928-29	1,023	337,478	330
1929-30	787	350,140	445
1930-31	828	375,464	453
1931-32	1,277	577,762	452
1932-33	971	393,356	405
1933-34	1,425	694,204	488
1934-35	1,499	733,276	489
1935-36	1,953	683,809	350
1936-37	1,883	744,864	396
1937-38	1,849	703,488	380
1938-39	1,767	575,900	326
1939/40*	1,800	630,000	330

*Estimate.

It will be seen that each succeeding year the United Kingdom has been taking an increasingly large percentage of our total exports. There is every reason to hope that she will continue to do so in spite of the fact that arrangements have been made to take over Turkey's entire exportable output this year. This deduction is arrived at from the following data(10):—

(i.) During the years 1934 to 1938 inclusive, maximum production in Turkey was reached in 1936 with a crop of 150,149,000 lbs. There is no reason to assume that the 1940 crop will exceed this amount. Even if it does, the amount normally retained for home consumption will restrict the quantity available for export to not more than 150 million lbs.

(ii.) Now in 1938 the United Kingdom retained 189,000,000 lbs. of Oriental tobacco for home consumption, but in addition 33,000,000 lbs. was manufactured for export, and adding 30,000,000 lbs. for offal rejected in manufacture, a grand total of 252,000,000 lbs. is arrived at. As Turkey's exportable crop will not exceed 150 million lbs. the United Kingdom is still in a position to purchase 102 million lbs. from other countries, so that Empire producing countries will not suffer from the Imperial Government's agreement with Turkey.

The outlook becomes even more hopeful when it is appreciated that a considerable proportion of the United Kingdom's imports from Turkey is to be used for blending purposes with Virginia and not to be manufactured into 100 per cent. "Turkish" cigarettes. Further, the preferential rate of duty granted by the Imperial Government to Empire producing countries does much to safeguard the interests of the Colonial producer.

Reverting to a perusal of Table II. we note that exports to Portuguese East Africa remain small; that there was no export trade with Belgium during the two export seasons 1938-39 and 1939-40; that the Argentine took nothing from us during 1939-40, and the exports to Holland have been gradually declining. Our exports to "Other Countries," however, show a very marked increase, brought about mainly by the increased interest being shown by American and Canadian buyers in our produce.

This increased interest does far more than compensate for the decline in exports to the Argentine, Belgium and Holland, for not only does it open up new markets, but it gives us a sound footing on increasingly large markets. In 1939-40 the United States of America alone took 119,256 lbs. and followed up this purchase in April, 1940, by taking a further 124,774 lbs.

Buyers in the States are so pleased with the manner in which our Turkish tobacco is graded, handled and packed by the Co-operative Company at Darwendale, that they are desirous of taking a million pounds weight of our product and of increasing this quantity to three million pounds in three years. Naturally, of course, this demand is for specified grades. At present we are unable to meet it owing to shortage of production (see Table III.), and lack of markets for the consequent increase in poorer grades which neither the United States nor Canada nor the United Kingdom would touch.

It is well to bear in mind, however, the potentialities of these three markets, and it should be our firm resolve to more and more establish ourselves on them. This can only be done by producing good quality leaf, by handling the leaf properly, and by taking care that no tobacco is exported which has not been thoroughly cleaned, properly graded and properly packed.

The Minister of Agriculture and Lands (Captain the Hon. F. E. Harris) speaking at the annual general meeting of the Rhodesia Tobacco Association on the 21st June, 1940, said that he thought Turkish tobacco had a big future in the Colony and that the growing of it should be encouraged.

All persons growing Turkish for the first time are advised to proceed in a small and experimental way by not growing more than five to ten acres until such time as they become familiar with the crop and have proved that their particular farms are suited to the production of this particular type of tobacco.

"The tobacco plant requires considerable attention and has an unpleasant way of retaliating when cheated out of it."

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Price List of Forest-tree Transplants, Ornamental Trees and Shrubs, Hedge Plants. Creepers and Seeds.

OBTAINABLE AT THE GOVERNMENT FOREST NURSERY, SALISBURY.

AS AT 1st NOVEMBER, 1940.

1. Transplants of forest trees, etc., as far as in stock, are obtainable at the subjoined rates.

2. Orders should be addressed to the Conservator of Forests, Salisbury; or Manager, Forest Nursery, P.O. Box 387, Salisbury.

3. **All orders must be accompanied by a remittance in cash, bank note, postal order, draft or cheque, made payable to the Department of Agriculture, Salisbury. Under no circumstances will plants or seeds be sent out or taken away from the Nurseries unless paid for. Stamps to the value of one shilling will be accepted.**

4. All transplants are despatched at Rate 10 on railways at purchaser's risk. The transplants are watered as far as this is possible by the railway staff.

5. All prices quoted are for delivery free at any station or siding in Southern Rhodesia. Road motor service charges are payable by consignee and must be included in remittances.

6. Purchasers of trees contained in tins either of 25 or 4 trees are requested to return the tins, carriage forward, to the nursery from which they were obtained, or to the Manager, Forest Nursery, Salisbury. **If the tins are not returned within two months from date of issue, they will be charged for at the current rate of petrol tins (9d. each).**

7. No trees will be reserved unless specially booked. Orders will be executed in order of receipt as trees are ready for despatch. Every effort will be made to comply with instructions of purchasers.

8. Transplants of forest trees, when quoted at per 1,000, are grown in half paraffin or petrol tins containing 20 to 25

transplants. The average weight of each tin is about 25 lbs. Height of transplants, about 3 to 12 inches.

9. Transplants of a larger size usually in stock, from 1 ft. to 3 ft., from 2s. 6d.; weight 10 to 50 lbs.

10. Shrubs and ornamental plants in single tins have a weight of about 5 lbs.

11. To purchasers of forest trees, the following reductions are made:—

(*a*) When the number exceeds 1,000, the price is £3 5s. per 1,000.

(*b*) When the number exceeds 5,000, the price is £2 14s. per 1,000.

(*c*) Special quotation for orders over 20,000.

12. Orders for seed are posted or railed free of charge.

13. Though every care is taken to supply trees and seeds true to name and of good quality, no guarantee can be given in this respect, more particularly in regard to seed.

14. Intending tree planters are invited to apply to the Conservator of Forests, Division of Forestry, Salisbury, for advice as to the most suitable trees for growing in the various climates and soils of the Colony, and on the best methods to adopt in the formation of plantations, wind breaks and shelter belts.

15. No responsibility taken after trees, shrubs, etc., have been accepted by the Railways. Any claim for loss or death should be made to the Railway Company.

16. This list cancels all previous lists.

17. Hours of Business.—Mondays, Tuesdays, Thursdays and Fridays, 9 a.m. to 1 p.m. and 2 p.m. to 4.45 p.m.; Wednesdays, 9 a.m. to 1 p.m.; Saturdays, 9 a.m. to 12.30 p.m. The Nursery is closed to visitors on Wednesday and Saturday afternoons, all day Sundays and Public Holidays.

Price of Transplants.—For convenience, the following symbols are used to indicate the purchase prices of transplants:—

A—Trees, 25 in tin, at 2s. 3d. per tin, £3 5s. per 1,000; £2 14s. per 1,000 for orders over 5,000.

C—Trees and shrubs, 4 in tin, at 4d. each.

D—Trees and shrubs, 4 in tin, at 9d. each.

E—Trees and shrubs at 9d. each; extra large up to 2s. 6d. each.

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed.	
				Lb.	Oz.
Callitris calcarata ...	Black cypress pine ...	Usually rather slow growing, but reaches a fair size and produces a valuable durable softwood. Suited for dry country planting, especially in sandy soil. Good shelter for orchards, etc.	A. C.	15s.	1s.
Casuarina cunninghamiana	Beefwood	A fine large shade tree, suitable for avenues and narrow belts. Requires deep soil in drier localities. The foliage is useful for stock fodder, and the tree stands lopping well.	A.C.	...	2s. pkt. 1s.
Cedrela odorata		A rapid-growing tree similar to Cedrela toona, but with lighter foliage. Likely to do well on heavy soils, fairly free from frost. 30 to 40 feet in height.	A.		
Cedrela toona	Toon tree	A rapid-growing, handsome, semi-deciduous tree, suited for moister localities where frost is slight. Yields a valuable soft timber. Recommended for shade and ornament.	A. C.	15s.	1s
Cupressus arizonica ...	Arizona cypress	A hardy evergreen tree, suitable for dry localities, but requiring a well-drained and rather deep soil. Useful for shelter belts and also for hedges when closely planted.	A. C.	15s.	1s.
Cupressus lusitanica ...	Portuguese cypress ...	A fast-growing cypress, producing an excellent softwood timber, but requires a moist, cool climate and a good soil. May well be used for shelter and hedges in favourable localities.	A. C.	5s.	6d.
Cupressus sempervirens, var. horizontalis	Common spreading cypress	A hardy cypress, suited for limestone as well as other soils. Not so frost or drought hardy as Cupressus arizonica. Suitable for shelter and hedges.	A. C.	15s.	1s.

Cupressus sempervirens, var. pyramidalis	Common upright cypress	An ornamental tree for gardens and cemeteries. Also useful as a shelter tree. Grows under similar conditions to the "var, horizontalis."	C.E.	15s.	1s.
Cupressus torulosa ...	Himalayan cypress	A good tree for timber, hedges and shelter. Withstands much cold and drought. Not very soil exacting. Fairly frost-hardy. A very reliable tree.	A. C.	10s.	9d.
Eucalyptus botryoides	Bangalay	A large-leaved, heavy-foliaged gum. Quick growing. Suitable for granite and red soils. Withstands frosts, but not very drought-resistant.	A.	15s.	1s
Eucalyptus citriodora ..	Lemon-scented gum ...	A clean-boled tree, producing an excellent timber. Leaves lemon-scented. Suited for wetter regions and on the better soils in the lower rainfall regions. Will not withstand much frost or drought. Flowers prolifically, rendering it very useful for honey production.	A.	15s.	1s.
Eucalyptus crebra... ...	Narrow-leaved ironbark	A slow-growing, deep-rooting species, producing excellent timber. Withstands drought and light frosts.	A	15s.	1s.
Eucalyptus maculata ..	Spotted gum	One of the best trees for timber production or shelter in the wetter areas, being fairly hardy to drought but not to frost. Produces an excellent timber.	A.	15s.	1s.
Eucalyptus maideni ...	Maiden's gum	A very fast-growing, large tree, with bluish foliage in youth. Fairly drought and frost resistant. Will grow on poor soils if deep and well-drained. Produces a good, strong, useful timber.	A.	30s.	2s.

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed.	
				Lb.	Oz.
Eucalyptus melliodora	Yellow box...	A medium-sized tree, useful for shelter belts. Produces a tough, durable timber. Very resistant to drought and frost. Valuable for honey production, having abundant sweet flowers.	A.	15s.	1s.
Eucalyptus paniculata	Grey ironbark	A very good timber tree, with heavy foliage. Suitable for the moister regions, with a deep, fertile soil. Withstands some drought, but is frost-tender. Yields an excellent, hard, durable wood.	A.	15s.	1s.
Eucalyptus punctata ...	Leather jacket	A tree of fair size, yielding a good, durable timber. Adaptable as regards soil and climate, but will not withstand a dry cold climate.	A.	15s	1s.
Eucalyptus robusta ...	Swamp mahogany	A quick-growing, shady tree, which requires a moist soil for best results, but will grow under fairly dry conditions, provided frost is not severe. Recommended rather for shelter belts than plantations.	A.	15s.	1s.
Eucalyptus rostrata ...	Red gum	Produces an excellent and durable hardwood. Withstands drought, heat, brak, flooding and a good deal of frost. One of the best species for planting in Southern Rhodesia, except in sour soil and wet mountain regions.	A.	15s.	1s.
Eucalyptus saligna... ...	Sydney blue gum	A fast-growing, useful tree, producing a useful medium hardwood. Thrives on deep, fertile soils in the heavier rainfall areas. Tender to frost and drought.	A.	15s.	1s.
Eucalyptus tereticornis	Forest red gum	Similar to Eucalyptus rostrata, and can be planted along with it, except in areas liable to flooding and great heat. Perhaps not quite as drought-resistant.	A.	15s.	1s.

Grevillea robusta	Silky oak	A handsome tree which thrives best in moist, warm localities. Useful for ornament, shade and timber. Frost-tender and not resistant to drought. If the locality is unsuitable, it may grow well for several years and then die out.	A. C.	...	pkt. 1s.
Jacaranda mimosaefolia	Jacaranda	An ornamental deciduous tree with feathery foliage and abundant blue flowers, which appear in spring. Best development is attained in the moister regions, but the tree withstands drought to a surprising extent. and may be planted in the drier regions if the soil is reasonably deep and fertile. It is tender to cold and frost, and may need protection in its earlier youth.	A. C.	20s.	1s. 3d. pkt. 1s.
Pinus canariensis	Canary Island Pine	Hardy to drought, but not to severe frost. Best suited for planting on higher altitudes and in higher rainfall areas. Slow growth in early youth. then more rapid in later years. A handsome tree with inverted. umbrella-like branches, not spreading. Yields an excellent softwood timber.	A. C.	15s.	1s.
Pinus halepensis	Aleppo pine	A drought-resistant pine which will grow on limestone and shale soils. Not recommended for plantations, but can be used for shelter and ornamental purposes in the drier regions.	A. C.	15s.	1s.
Pinus patula	Patula pine	A fast growing pine with graceful drooping needles. Does best in higher rainfall areas. Produces a useful softwood.	A.C.	15s.	1s.
Pinus radiata (insignis)	Remarkable pine	A large tree of very rapid growth. producing a useful softwood. Most at home in the heavier rainfall areas. Does not like sour or poorly-drained soils. Frost-hardy but not drought-resistant. usually failing at an early age in the drier regions.	A. C.	15s.	1s.
Pinus longifolia	Chir pine	A somewhat slow-growing pine, but useful to plant in localities where the climate and soil are doubtful at the higher elevations. For timber and ornamental purposes. A useful tree in all respects.	A. C.	15s.	1s.

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed.	
				Lb.	Oz.
Populus alba	White poplar	A rapid-growing poplar, requiring a good, deep soil in close proximity to running water. Propagated by suckers. Deciduous.	Suckers at 9s. per 100		
Populus deltoides, var. missouriensis	Carolina poplar...	A very fast-growing poplar, producing a very good timber for match boxes. Requires a rich, moist, alluvial soil. Moderately frost-hardy. Does not like stagnant water.	E.		
Salix babylonica	Weeping willow	A useful timber and ornamental tree, requiring a moist, well-drained soil which is occasionally flooded. Not suited for ground in which water is stagnant.	C.E.		
		Ornamental Trees, Shrubs and Hedge Plants.			
Abelia floribunda	—	A shrub with myrtle-like leaves, evergreen if watered. Pink-white flowers in profusion. Is used for hedges in Natal.	E.		
Aberia caffra	Kei apple	A rough, thorny, impenetrable shrub, making a good hedge. Withstands frost and drought well. Suited for all but the driest areas of the Colony. More useful than ornamental. Slow growing.	E.		
Acacia baileyana	Silver wattle	A small ornamental tree with blue foliage and yellow flowers.	E.		
Acalypha marginata ...	—	Margin of leaf crimson; a shrub; will grow to 10 feet in height, or clipped to shape. Very useful to give colour to shrubbery.	E.		
Acrocarpus fraxinifolius	—	A small tree up to 25 feet in height; attractive foliage.	E.		
Agapanthus umbelatus	Cape Lily	Blue and white varieties.	E.		
Aleurites fordii...	Tung oil	An important oil-bearing tree from China. 25 to 30 feet in height.	E.		
Aloysia citriodora... ...	Lemon-scented verbena	A small shrub with a strongly lemon-scented foliage. Hardy, vigorous, quick-growing.	E.		

Alstonia scholaris	—	A white flowered shrub, 6 feet high, similar to Oleander.	E.	
Anona reticulata	Custard Apple	Small deciduous bush up to 10 feet high, bearing the well known custard apple.	E.	
Bauhinia galpini	Pride of de Kaap	A rambling shrub, bearing orange-red flowers. Hardy.	E.	pkt. 1s.
Bauhinia acuminata	Bauhinia	A large, indigenous shrub, flowering profusely in early spring. White flowers. Hardy.	E.	pkt. 1s.
Bauhinia purpurea	Bauhinia	Similar to the Bauhinia acuminata, but with mauve flowers. Hardy.	E.	pkt. 1s.
Bolusanthus speciosus	Rhodesian tree wistaria	An indigenous semi-deciduous tree with blue flowers at the end of long stalks. Ornamental.	E.	
Brugmansia knightii	Moonflower	A flowering shrub with large, drooping, white flowers. Strong scent (of lily). Fairly frost-hardy.	E.	
Buddleia sp.	Blue buddleia	A medium-sized shrub with sweet-scented blue flowers. Useful as a hedge. Rapid-growing, but frost-tender.	E.	
Buddleia sp.	Yellow buddleia	A rank-growing, yellow-flowering shrub. Useful as a hedge. Rapid-growing. Frost-tender.	E.	
Callistemon speciosus	Bottlebrush	A scarlet-flowering shrub of drooping habit. Makes an excellent hedge if trimmed along the top only.	A.C.E.	2s. pkt. 1s.
Carica papaya	Pawpaw	A small tree with a large, dark green foliage, bearing large edible fruits.	E.	
Casimiroa edulis	Mexican apple	A large, rapid-growing tree, 30-40 feet in height, evergreen, and bears a delicious fruit. A fine shade tree.	E.	
Cassia capensis	Cape laburnum	A rapid-growing shrub, bearing masses of bright yellow flowers.	E.	
Cestrum aurantiacum	Ink berry	A small shrub, bearing orange flowers in profusion.	E.	
Castanospermum australe	Australian chestnut	A very fine shade tree similar in growth to Cedrela but with shiny evergreen leaves and pretty flowers.		1s. and 2s. 6d. each.

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed.	
				Lb.	Oz.
Croton sylvaticus	Mount Selinda linden	A large-leaved, deciduous tree from Melsetter.	E.		
Cyphomandra betacea	Tree tomato	The well-known tree tomato. Will grow anywhere where Paw Paws will thrive.	E.		
Dahlia imperialis	Tree dahlia	A medium-sized shrub, making a handsome show with its single white blooms.	E.	...	pkt. 1s.
Dalbergia sissoo	Sissoo	A large deciduous tree from India, producing an excellent timber. Desires a deep, porous, well-drained soil in close proximity to running water. Will not tolerate stiff clay. Frost-hardy, but not very drought-resistant. Rapid-growing.	E.		
Datura arborea...	Tree potato	A large shrubby tree, up to 30 feet in height, with large purple flowers. Very quick grower. Fruit poisonous.	E.		
Deutzia crenata	Bridal wreath	A small deciduous shrub with double white flowers, tinged slightly pink, on long, drooping stalks.	E.		
Dombeya sp.	—	A small shrub 6 feet high, pink flowers.	E.		
Duranta plumieri	Tree forget-me-not... ...	A medium-sized, deciduous shrub with blue flowers. Useful as a hedge. Very hardy.	E.		
Eranthemum sp.	—	A shrubby herbaceous plant covered with intense blue flowers in the autumn, likes shade, evergreen, 3 feet high.	E.		
Eugenia braziliensis ...	Brazilian cherry	A small shrub, bearing orange-coloured, edible fruits. A useful hedge plant.	E.		

Euphorbia splendens	Christ thorn	A small thorny shrub with bright scarlet flowers. Suitable for low hedges and borders.	E.
Freylinia tropica	Inyanga hedge plant	A useful hedge shrub. Indigenous.	E.
Gardenia florida	Katjepeering	A compact, evergreen shrub with dark green, glossy leaves and pure white, sweetly-scented double flowers.	E.
Hamelia patens	—	A compact shrub 8 feet to 10 feet in height, flower orange-yellow tubes, a showy shrub.	E.
Heliotropium peruvianum	Heliotrope	A small shrub with sweet-scented lilac or nearly white flowers. Suitable in flower border.	E.
Hibiscus rosa-sinensis	Chinese rose	Evergreen shrub with numerous scarlet flowers. Double and single varieties.	E.
Holmskioldia sanguinea	Holmskioldia	A fairly hardy shrub, bearing a profusion of brick-red flowers in large bunches. Suitable for hedges.	E.
Holmskioldia sp.	Holmskioldia	A yellow-flowering, handsome shrub similar to Holmskioldia sanguinea.	E.
Hydrangea japonica	—	A well-known shrub. The flowers are naturally pink, and are changed to blue by feeding the plants with small quantities of Nitrate of Soda, as they grow.	E.
Hypericum lanceolatum	St. John's wort	A small, yellow-flowering shrub. Multitudes of flowers.	E.
Iochroma tubulosa	Iochroma	A shrub with dark blue flowers.	E.
Lagerstroemia indica	Pride of India	A large ornamental shrub, with mauve and pink flowering varieties. Handsome and hardy.	E.
Ligustrum lucidum	Chinese privet	An excellent hedge plant or ornamental shrub or tree. Can be clipped into shape. Liable to die off in patches or lose its lower leaves unless planted in moist soil of fair depth. Propagated from cuttings.	A.C.
Lagunaria patersonii	—	An evergreen tree with pink flowers, 30 feet high.	E.
Mangifera indica	Mango	The well known fruit tree.	1s. to 2s. 6d. each.
Melia azedarach	Syringa	A deciduous tree, producing a good light timber. Shallow rooting. Withstands drought well. Has fine lilac flowers and persistent yellow berries. Suitable for better rainfall areas and deep sandy soil, but will grow under severe conditions.	E.

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed.	
				Lb.	Oz.
Morus sp.	Mulberry	A very large fruited variety.	E.		
Moschosma	Rhodesia spirea...	A medium-sized, blue-flowering shrub.	E.		
Nerium oleander	Ceylon rose	The Oleander. Salmon-pink, also a white variety.	E.		
Parkinsonia aculeata ...	Jerusalem thorn	A light foliaged tree, up to 20 feet high, with little yellow flowers, very beautiful as isolated specimen on a lawn.	E.		
Persea gratissima	Avocada pear	A shrub with an edible fruit.	2s. 6d. each		
Philadelphus coronarius	Mock orange...	A pretty deciduous shrub, large scented white flowers in early spring.	E.		
Photinia japonica	Loquat...	A small evergreen tree with large leaves, bearing yellow edible fruit.	E.		
Phytolacca dioica	Belhambra	A rapid-growing, deciduous tree. Useful for ornament. Timber of no value, but seeds valuable as a poultry or cattle feed.	A.	...	pkt. 1s.
Pittosporum undulatum	Camphor laurel...	An Australian evergreen shrub, making an excellent hedge, with shining, green, scented leaves and scented berries.	A.C.		
Plumiera rubra	Frangipani	A handsome shrub with pinkish red flowers. Rather delicate.	2s. 6d. each		
Plumiera occulata	—	Similar to Plumiera rubra with white flowers.	2s. 6d. each		
Poinciana gillessii	Bird of Paradise flower	A shrub grown to 10 feet in height, thorny, flowers in clusters, orange-gold and red.	E.		
Poinciana regia	Flamboyant	A handsome red flowering, feathery foliaged tree.	1s. to 7s. 6d.		
Poinsettia pulcherrima	Poinsettia	A shrub with small yellow flowers surrounded by many large, scarlet, leaf-like bracts. Very showy. Double and single varieties. Also single pink variety.	E.		
Poinsettia albida	Poinsettia	As above, but with single yellowish white bracts.	E.		
Psidium pomiferum ...	Guava	A small, hardy, evergreen tree, bearing edible, yellow fruit.	D. E.		

Punica granatum	Pomegranate	A shrub or small tree, having shining leaves, large scarlet flowers and large red fruit. Makes a useful hedge when well cut regularly.	E.		
Pyracantha angustifolia	Hawthorn	Fruits golden and hang throughout the winter. Evergreen shrub. Useful as a coarse hedge.	A.C.E.		
Pyracantha crenulata ..	Hawthorn	Fruits scarlet. Evergreen shrub if watered in winter. Makes a good border or low hedge.	A.C.E.		
Rhus lancea...	Karreeboom...	A small indigenous tree of graceful appearance, yielding a very durable wood. Useful for ornamental purposes. Forms a fine hedge.	A.	10s.	9d.
Roses (bush)...	—	An assortment of roses of about fifteen kinds, Teas, Hybrid Teas and Hybrid perpetuals, are usually on hand at 1s. each. These roses are struck from cuttings, but are not named.	1s.		
Russelia juncea...	Coral fuchsia	A pretty red-flowered shrubby plant about 6 feet high.	E.		
Salvia involucra	Salvia	Shrubby herbaceous perennial, growing to six feet in height. Red flowers. Very suitable for cutting.	E.		
Spathodea campanulata	African flame tree... ...	A handsome. heavy-foliaged tree, bearing bright red flowers. Suited for the heavier rainfall areas on deep soils.	E.		
Spirea prunifolia	Cape May...	White flowered shrub four feet in height, in single and double varieties.	E.		
Streptosolon jamesonii	Streptosolon...	A shrub with orange-coloured flowers in dense masses and pale green foliage. Very frost-tender and delicate.	E.		
Tecoma smithii...	Tecoma	An upright, medium-sized shrub with tubular, bright yellow flowers. Forms a useful hedge. Fairly drought-resistant.	A. E.	...	pkt. 1s.
Tecomaria capensis ...	Kaffir Honeysuckle ...	A pretty trailing shrub from the Cape, with orange flowers.	E.		
Thevetia neriifolia... ...	Thevetia	An evergreen shrub, bearing bell-shaped, yellow flowers. Hardy.	E.		

Botanical Name.	Common Name.	Remarks.	Plants each.	
Thuya orientalis	Thuya	A very hardy conifer that withstands heat, cold and drought, and does not mind heavy soils. Slow-growing. Of small size. Very good for hedges.	A.C.	... **pkt. 1s.**
Trichilia emetica	Natal Mahogany	A fine shade tree, evergreen, slow in growth, height to 30 feet. spread up to 50 feet.		**1s. 6d. to 2s.6d.**
Zithryllum sp.	—	A deciduous shrub up to 15 feet in height, grown for its lovely leaves. which become highly coloured in autumn.	E.	
		Climbers and Creepers.		
Ampelopsis veitchii ...	Virginia creeper	Too well known to need description.	E.	
Antigonon leptopus ...	Coral Creeper	A showy climber, bright pink flowers, forms large bulbs underground. Takes two or three years to reach flowering size, after this it makes a wonderful display yearly.	E.	
Aristolochia elegans ...	Dutchman's pipe	A rank-growing creeper. Heart-shaped leaves. Purplish crimson flowers. spotted yellow.	E.	
Beaumontia grandiflora	Beaumontia	A large climber with heavy, glossy foliage. Large white, bellshaped flowers. Blooms profusely. Fairly frost-tender.	1s 3d.	
Bignonia venusta	Golden shower	Vigorous creeper. Rapid-growing. Bears masses of orange flowers all the year round. Very useful and hardy.	1s. 3d.	
Bignonia speciosa	Bignonia	A rapid-growing, showy creeper, bearing large mauve flowers. Decumbent.	E.	
Bougainvillaea splendens	Bougainvillaea	Vigorous climber. May be also used as a hedge. Bracts magenta. Fairly frost-hardy.	1s. 3d.	

Ficus repens	—	A valuable climber for walls, etc., used in places where the Virginia creeper is grown, but clings to the surface much better than the latter, rather slow at first.	E.
Hedera helix	Ivy	A dark evergreen climber. Best in shady, cool climates.	E.
Jasminum sambac	Jasmine	A vigorous, evergreen shrub climber with large trusses of fragrant, white flowers.	1s. 3d.
Jasminum primulinum	Climbing jasmine	A yellow-flowering species similar to Jasminum grandiflorum.	E.
Lantana salviifolia	—	A fine little creeping shrub with pink flowers, very suitable for rockwork, or edging borders, etc.	E.
Lonicera periclymenum	Honeysuckle (Woodbine)	Hardy climber with sweet-scented yellow flowers.	E.
Lonicera sempervirens	Red honeysuckle	Climber with red flowers. Best kept well pruned or base becomes ugly.	E.
Mandevilla suaveolens	Mandevilla	Deciduous climber, bearing trumpet-shaped, white, fragrant flowers. Very slender.	E.
Passiflora edulis	Granadilla	A quick-growing climber, bearing edible fruits. Subject to woolly aphis if overshaded. A good trellis plant.	E.
Podranea brycei	Zimbabwe creeper	A rank-growing indigenous creeper with large, pink flowers.	E.
Rosa bracteata	Macartney rose	Plant with large green foliage and numerous white single flowers. Useful as a hedge plant.	1s.
Solanum wenlandii	Blue potato creeper	A rapid-growing creeper with tubular, blue flowers. Not frost-hardy.	E.
Wistaria frutescens	—	The well-known climber with lavender coloured panicles of flowers.	E.

Palms, Bamboos, etc.

Botanical Name.	Common Name.	Remarks.	Plants each.
Arundo donax	Spanish reed	A reed growing 20 feet to 25 feet in height and 1 inch thick, and very superior to the indigenous variety.	Offsets 1s. 6d. each
Bambusa fortunei	Fortune's bamboo	A small variety, 6 feet high, with canes about the thickness of a lead pencil, extremely useful for stakes in the garden.	Offsets 2s. 6d. each
Bambusa arundinacea	Whipstick bamboo	About 30 feet.	Offsets 2s. 6d. each
Bambusa sp.	Indian variety	Similar in growth to the Bindura, with very useful rods.	Offsets 2s. 6d. each.
Cortaderia argentea ...	Pampas grass	With long white plumes about 6 feet in height; must be grown near water or close to a tap.	Offsets 2s. 6d. each
Cyperus papyrus	Papyrus Grass	A very handsome subject for the water garden, or planted near the drip of a tap; it does best when growing in the water.	2s. 6d. each
Oxytenanthera abyssinica	The Bindura bamboo ...	The only variety indigenous to Rhodesia, giving very useful solid rods, very tough.	Offsets 2s. 6d. each.
Phoenix reclinata	Wild date palm...	A very hardy palm, indigenous to the Colony.	—
Phormium tenax	New Zealand flax	A useful green foliaged plant, about 4 feet high with sword-like leaves.	E.
Washingtonia robusta	Fan palm	A strong-growing fan palm.	—

Palms 2s. 6d. to 5s. each.

Offsets of Bamboos supplied during January only.

Southern Rhodesia Veterinary Report.

OCTOBER, 1940.

DISEASES.

African Coast Fever was diagnosed on Farm Roodebult, in the Salisbury native district.

TUBERCULIN TEST.

Forty-five bulls and ten cows were tested with negative results.

MALLEIN TEST.

Twenty-two horses were tested. There were no reactors.

IMPORTATIONS.

From Union of South Africa.—Bulls, 51; cows, 12; horses, 21; sheep, 1,971.

From Bechuanaland Protectorate.—Slaughter cattle, 204; sheep, 260; goats, 10.

EXPORTATIONS.

To Northern Rhodesia.—Bulls, 43; pigs, 6.

To Portuguese East Africa.—Slaughter cattle, 117.

To Union of South Africa.—Horses, 1.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

To United Kingdom.—Beef quarters (chilled quality), 78; tongues, 6,792 lbs.; livers, 20,139 lbs.; tails, 2,791 lbs.; kidneys, 2,072 lbs.

To Northern Rhodesia.—Beef carcases, 371; mutton carcases, 100; veal carcases, 11; offal, 19,616 lbs.

To Belgian Congo.—Beef carcases, 62; mutton carcases, 10; pork carcases, 60; veal carcases, 10; offal, 4,459 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa.—Corned beef, 27,744 lbs.; beef paste, 44 lbs.; sausages, 563 lbs.; tin stew, 336 lbs.

To Northern Rhodesia.—Meat meal, 3,000 lbs.

B. A. MYHILL,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-40.

Monthly Report No. 95. October, 1940.

Red Locust (*Nomadacris septemfasciata*, Serv.).—Winged swarms have been reported during the month from seven districts, namely, Inyanga, Melsetter, Belingwe, Bulawayo, Insiza, Bubi and Hartley.

All specimens received have been of red coloration and dissection has not indicated any appreciable development towards the breeding stage.

No general trend of direction of flight is apparent from the reports received.

RUPERT W. JACK,
Chief Entomologist.

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Agricultural Journal.

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the Minister of Agriculture and Lands.

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